Section 1 PIFT Overview

Terminal Objective:

Upon completion of this section, the student will understand when and under what circumstances they can safely transfer a patient following the PIFT guidelines.

Enabling Objectives:

The student will be able to:

(Section 1, Objective 1) Identify the eligibility requirements for PIFT certification

a. In order to be eligible to perform transfers under the Maine EMS PIFT program, the participant must be a MEMS licensed paramedic and have successfully completed the Maine EMS PIFT Program or equivilant Maine EMS approved Critical Care Transport Program

(Section 1, Objective 2) Describe the impact legal issues have on arranging interfacility transports.

a. The law requires that patients who are being transferred from one facility to another facility for a higher level of care continue to receive appropriate medical care during transport. The sending facility is legally responsible for ensuring that the mode of transport and personnel accompanying the patient during the transport are appropriate for this particular patient at this particular time.

(Section 1, Objective 3) Explain the fundamental principals of COBRA/EMTALA

a. EMTALA (Emergency Medical Treatment and Active Labor Act) was originally passed in 1985 as part of COBRA (The Consolidated Omnibus Budget Reconciliation Act)…..EMTALA is sometimes referred to as the Anti-Dumping law since it was passed to prevent hospitals from refusing to treat indigent persons or transferring them inappropriately to other facilities.

b. EMTALA requires hospitals to provide a medical screening examination for all patients seeking medical attention in order to determine if a medical emergency situation exists.

c. A patient may not be transferred to another facility if they are at risk to deteriorate from or during transfer unless the current hospital cannot meet the needs of the patient.

d. Furthermore, the patient may not be transferred if they are unstable and remain at risk of deterioration unless the sending physician certifies in writing that the benefits to be obtained at the receiving hospital justify the risks of transfer.

e. The patient must be accepted by the receiving hospital prior to transfer; the receiving hospital must accept the patient if it has the space and the skills necessary to care for the patient.

f. The patient or a legally responsible person must request the transfer after being advised of the risks and benefits of transfer.

g. The sending hospital must provide whatever treatment is within its capabilities to ensure that the patient is stabilized prior to transfer.

h. The sending hospital is required to make appropriate arrangements for transfer that include the following:

   - Appropriate personnel and equipment must be provided; in certain cases it might be necessary for a physician or other healthcare specialist to accompany the patient

   - All relevant medical records must be sent with the patient

   - An ambulance service may not be charged with an EMTALA violation unless it is a hospital-owned service. BUT……..An ambulance service may still be sued by either the sending hospital or the patient for negligence or misrepresentation if it fails to provide the appropriate personnel and equipment requested by the sending facility. Eg. A sending facility requests an ALS equipped ambulance staffed by an ACLS certified paramedic to transfer a cardiac patient to another hospital. The service provides only a BLS ambulance with an EMT and fails to advise the sending facility that it is not providing the equipment and personnel that were requested. If the patient requires ALS treatment during transport and suffers damages, the EMS service may be liable.

(Section 1, Objective 4) Compare the roles and responsibilities of a PIFT Paramedic, a Paramedic, an RN or other health care provider on a patient transfer.

a. All medical personnel accompanying a patient on an interfacility

transfer have the primary responsibility of monitoring the patient and providing interventions as allowed by their individual training, Licensure, and experience.

(Section 1, Objective 5) Differentiate between medications and devices that a PIFT trained Paramedic can monitor/utilize in the field (routine day to day calls) and the medications and devices that a PIFT trained paramedic can monitor/utilize on interfacility transports.

a. Advanced Life Support Crew
   - Transfers of those patients with treatments, procedures, and medications considered within the normal paramedic scope of practice as defined by Maine EMS rules.

   - IV Medications that can be monitored/administered by MEMS licensed paramedics include:

Adenosine	Diphenhydramine (Benadryl)	Lidocaine
Sodium Bicarb	Albuterol	Dopamine
Magnesium Sulfate	Nitroglycerin (oral)	Atropine
Epinephrine	Meperidine (Demerol)	Nitrous Oxide
Bretylium	Furosemide (Lasix)	Morphine
Terbutaline	Dextrose	Glucagon
Naloxone (Narcan)	Thiamine	Diazepam (Valium)
Heparin (IV Lock only)	Promethazine	Fentanyl
Midazolam (Versed)	Lorazepam (Ativan)	Tetracaine

   - Paramedics may transport patients with central lines as long as the medications running are contained on this list. Hemodynamic monitoring through a central line is not a paramedic skill.

b. Paramedics who have completed Maine EMS Interfacility Transport Program
   - In addition to the baseline established by the normal standard of care, Paramedics who have completed the Interfacility transport program may transport patients who, in the sending physicians (and paramedics) opinion, are hemodynamically stable and have one or more of the following classifications of medications running:
     1. Anticoagulants
     2. Anticonvulsants
     3. Antidiabetics
     4. Antidysrhythmics
     5. Antihypertensives (including ACE inhibitors, Calcium Channel Blockers, Diuretics, Alpha Blockers and Beta Blockers)
     6. Anti-infectives
     7. Antipsychotics

8. Cardiac Glycosides
9. Corticosteroids
10. Gastrointestinal Agents (including H2 Blockers, PPI's and Somatostatin and its analogues)
11. IV Fluids, Electrolytes (including Dextran, Albumin, and Hetastarch)
12. Drotrecogin
13. Narcotics (including all routes except epidural)
14. Parenteral Nutrition
15. Platelet Aggregation Inhibitors (including IIb/IIIa Inhibitors)
16. Respiratory Medications (Beta Agonists, Anticholinergics, Mucolytics and Steroids)
17. Sedatives (Benzodiazepines, Barbiturates)
18. Vasoactive Agents (Antihypertensives, Pressors/sympathomimetics)

- Paramedics may actually be administering some of these medications as required by the patient condition and allowed by physician order and training. Paramedics may transport patients with central lines as long as the medications running are contained on this list.

(Section 1, Objective 6) Describe when the medications and devices allowed in the PIFT program can be utilized.

a. The Maine EMS PIFT program can be used ***during interfacility transport*** when the patient condition and stability is such that they can be managed appropriately by a single paramedic in the patient care compartment.

(Section 1, Objective 7) Define when a paramedic can transport a patient under the PIFT guidelines.

a. A paramedic can transport a stable patient who is having a medication and/or device administered that has been identified as appropriate under the Maine EMS PIFT program.

(Section 1, Objective 8) Describe the importance of receiving a detailed patient report and specific physician orders prior to patient transfer.

a. An integral part of the MEMS PIFT program is the additional responsibility placed on the paramedic for assuring appropriate transport and patient management. In order to accomplish this goal, the paramedic must have a detailed understanding of the patient history as it relates to this current treatment plan as well as additional relevant patient history and physician instructions for managing patient

change during transport.

(Section 1, Objective 9) Describe the components of a detailed patient report given to the receiving facility.

a. The Paramedic is a key part of the patient care team and must take responsibility for continuing the communication link that passes critical patient information between caregivers. Information that should be passed along to the receiving facility include: History received from the sending facility; assessment findings during transport; patient general condition; treatments administered and/or altered during transport; patient response to treatments or changes.

(Section 1, Objective 10) Identify the general concepts of patient stability

a. A patient is considered "stable" when there is no foreseeable likelihood of material deterioration in the condition of the patient as a result of or during the transport.
    - Assessment of stability will require:
        1. Hemodynamic and neurologic signs which have demonstrated no deterioration from the acute presentation of the patient, or are within acceptable limits of variation on existing therapy and may be reasonably predicted to remain so during the transport without the need for further adjustments to such therapy; and
        2. The pathophysiology of the patient's acute condition is known to favorably respond to the therapeutic interventions which have been undertaken at the sending hospital

b. Actions required of sending hospital and transport personnel ***prior to transport:***
    - Proactive interventions to stabilize the patient's condition and prevent deterioration; and

c. Actions required of transport personnel ***during transport:***
    - Aggressive enroute interventions to reverse or mitigate deterioration in the condition of the patient

(Section 1, Objective 11) Discuss appropriate steps to deal with patient deterioration during transfer.

a. Patient must be regularly re-assessed in order to identify changes in patient condition as soon as possible. Paramedics must be acutely aware of specific physician orders regarding this patient and the medications that are being administered so that alterations may be made as ordered to accommodate patient condition. If the changes in the patient are dramatic, the paramedic should attempt to contact medical control at the sending (1st choice) or receiving (2nd choice) facility for direction. In extreme circumstances, the paramedic ***may consider*** discontinuing the medication and utilize existing MEMS protocols to manage the patient. The transporting crew should also consider diverting to the closest hospital with an emergency department for assistance.

(Section 1, Objective 12) List actions/treatments that require the sending facility to send additional transport personnel

a. Patients who are not stable according to the definition listed previously.
b. Patients who are on medications or equipment that is not included in the PIFT program.
c. Situations where the paramedic is not comfortable transporting without additional hospital personnel

(Section 1, Objective 13) Define the role of the PIFT Paramedic in the transport decision.

a. The final decision on whether the patient can be transported under the PIFT program will be made by the transporting paramedic.

(Section 1, Objective 14) List the standards and guidelines that help ensure safe and effective ground transport.

a. A safe and effective interfacility transport requires the use of adequately trained personnel utilizing appropriate equipment for the management of the patient.

(Section 1, Objective 15) List the components of a pre-trip check on all necessary equipment to ensure proper understanding and operation.

a. Transferring paramedic receives a report on patient conditions, medications running, and required equipment prior to leaving to pick up patient.
b. Paramedic conducts an inventory to ensure that they have the appropriate equipment, gas levels, and resources for the requested transport.
c. Paramedic reviews operation of any required equipment to ensure

proper familiarity with operation.

Section 2 Medical Direction and QI

Terminal Objective:

Upon completion of this section the student will be able to describe the components of medical control and continuous quality improvement.

Enabling Objectives:

The student will be able to:

(Section 2, Objective 1) Identify the key roles of the service medical director for the interfacility transfer program.

a. Medical Oversight

Prospective	Off-line	Indirect	E.g., SOG development
Concurrent	On-line/On-scene	Direct	E.g., giving orders via radio
Retrospective	Off-line	Indirect	E.g., quality management

b. The medical director is an integral component to a successful program. Minimum requirements include knowledge of EMS prehospital and PIFT protocols; knowledge and active participation in service, hospital, regional and state QI programs; 100% review of all PIFT transfers; and availability for discussion on PIFT transfers. The medical director is further encouraged to be an ambassador to local hospitals, acute and chronic care facilities, and medical staffs to help support and clarify the role of paramedics in these types of transfers.

(Section 2, Objective 2) Define the role of the Medical Director in regard to transport decisions.

a. Transport decisions are ultimately left to the discretion of the paramedic providing the PIFT level transfer. The medical director is expected to be able to offer support to the paramedic and provide educational or system support if issues of competency arise. Discussions of “borderline” transfers may require the medical director to speak with the authorizing physician, and this is an expectation that

should be offered willingly and easily.

b. ***Outcome Evaluation*** — Examines the effectiveness or efficacy of particular interventions on patient status. An outcome evaluation of IFT assesses a particular clinical aspect of patient care during IFT, and its impact on patient outcome.
c. ***Process Evaluation*** — Process evaluation focuses on the quality of implementation — how well the process was carried out. It examines operational and system efficiency. It would be difficult to arrive at the conclusion that a specific intervention caused a specific outcome if the process of achieving it was not carried out as intended.

(Section 2, Objective 3) Describe the components of the interfacility transport QA/QI program.

a. Prospective evaluation is a key component of the PIFT program. This first pass approval is really where the QI program begins. Once a decision to proceed has been made, then the QI form should be filled out completely. This form will delineate the definitions of stability which will be reiterated here:

    - A stable “Low Risk” Patient: A patient who has hemodynamic and neurological stability with no foreseeable deterioration. This is the patient who is not suffering from an acute illness, but has medications or interventions being administered which are outside of the scope of the Paramedic without PIFT training.

    - A stable “Moderate Risk” Patient: A Stable patient is one who has hemodynamic and neurologic stability from therapies initiated. Therapies initiated must be expected to maintain patient stability during the transport. This patient is typically going via emergent transfer to a tertiary facility for services not readily available at a local facility. Variation on existing therapy has demonstrated no deterioration and may be reasonably predicted to remain without change during the transport without the need for further adjustments to such therapy.

    - An unstable “High Risk” patient and those receiving interventions outside the scope of the PIFT module will require the sending facility to provide other appropriate staff to assure appropriate clinical care during transport. Vital signs and interventions will be recorded, and any variance requiring contact of OLMC will be recorded. This must be kept for 3 years, and should be made available to regional or state QI staff when requested.

b. Complete the required QI forms used in interfacility transport.
    1. This requirement is expected to have a bench mark of 100%

compliance and the form should always be entirely completed.

(Section 2, Objective 4) Define the role of the emergency department clinician in providing medical control in unusual circumstances.

a. The emergency department physician can provide guidance to any crew when patient safety is ever an issue. If prospective information from the sending physician can be provided, that would be most helpful. In circumstances where prospective (anticipatory) information is not available, then the paramedic or the paramedic's designee should give the salient information and receive medical advice/orders.

(Section 2, Objective 5) Using a case study of a hospitalized patient requiring transport, the PIFT paramedic will:

a. **EXERCISE:** Perform a patient assessment and determine eligibility for PIFT transfer.
b. **EXERCISE:** Document criteria used to determine eligibility.
c. **EXERCISE:** Develop transfer plan to include, medications, personnel, medical devices, patient care, patient reports, and QI forms

Section 3 Utilizing PIFT Resources

Terminal Objective:

Upon completion of this section, the student will recognize and appropriately utilize available drug resources.

Enabling Objectives:

The student will be able to:

(Section 3, Objective 1) List at least three available print drug resources according to the MDPB PIFT resource list.

a. PIFT related print resources currently recognized by the MDPB include, but are not limited to the following:

- Statutory and Regulatory
    1. Maine EMS Prehospital Treatment Protocols (July 1, 2005)
    2. Title 32 Chapter 2B Maine EMS Act 1982 (August 4, 2004)
    3. Maine EMS Rules effective July 1, 2003
    4. EMTALA Statute- Emergency Medical Treatment and Active Labor Law - www.dol.gov

5. COBRA Statute-Consolidated Omnibus Budget Reconciliation Act – www.cms.hhs.gov
6. HIPAA – Portability of Health Coverage – www.cms.hhs.gov

- Interfacility Drugs-Text
  1. Shannon, Wilson, Stang. Health Professionals Drug Guide. Prentice Hall, 2006
  2. Springhouse. Nursing IV Drug Handbook. Lippincott, 9e
  3. Bledsoe, Clayden. Prehospital Emergency Pharmacology. Brady, 2005, 6e.

- Paramedic Emergency Care-Text
  1. Bledsoe, Benner. Critical Care Paramedic. Brady, 2006.
  2. Bledsoe, Porter, Cherry. Essentials of Paramedic Care. Brady, 2006, 2e.

(Section 3, Objective 2) List at least one available electronic drug resource according to the MDPB PIFT resource list.

a. PIFT related electronic resources currently recognized by the MDPB include, but are not limited to the following:
   - Epocrates – PDA products - www.epocrates.com
   - Lexidrugs – PDA pproducts – www.lexidrugs.com
   - PEPID – PDA products – www.PEPID.com
   - PDA, PC, Laptop, Tablet resources

(Section 3, Objective 3) EXERCISE: Demonstrate the ability to procure specific drug information using an MDPB PIFT drug resource.

(Section 3, Objective 4) EXERCISE: Demonstrate the ability to make an appropriate drug specific transport decision in a practical scenario.

Section 4 Pharmacology

Terminal Objective:

Upon completion of this section the student will understand the fundamental principles of pharmacology including autonomic nervous system, pharmacodynamics, pharmacokinetics, mechanism of action, drug distribution, absorption, biotransformation, and excretion.

Enabling Objectives:

The student will be able to:

Section 4 Part I: Nervous System Review

Note: This should be a relatively brief session focused primarily on review of existing knowledge included in the national standard NHTSA paramedic curriculum

(Section 4, Objective 1) List the two major subdivisions of the nervous system and explain how autonomic nerve impulses are conducted.

a. The nervous system is divided into two major subdivisions that should be understood by the paramedic

    1. Central nervous system is made up of the brain and spinal cord
    2. The peripheral nervous system is essentially made up of nerves that originate in the brain or spinal cord.
    3. The peripheral nervous system is further subdivided into the afferent and efferent divisions
    4. The part of the efferent division that controls involuntary bodily functions such as cardiac function, body temperature, smooth muscle, glands and arterial blood pressure is known as the AUTONOMIC NERVOUS SYSTEM.

(Section 4, Objective 2) List and define the two functional divisions of the autonomic nervous system and identify the neurotransmitters for both functional divisions..

a. Divisions of the Autonomic Nervous System
    - Sympathetic nervous system----This is the part of the autonomic nervous system that prepares the body to function under stress (Fight of Flight).
        a. **Neurotransmitters** are chemical substances released by the neuron to act on the target cell to either excite or inhibit it.
        b. Primary neurotransmitters of the sympathetic nervous system are **epinephrine** and **norepinephrine**.
        c. A drug that stimulates the sympathetic nervous system is known as a **Sympathomimetic** or **adrenergic** drug---Eg. Epinephrine
        d. A drug that inhibits the sympathetic nervous system is known as a **Sympatholytic** or **antiadrenergic** drug—ex. beta blockers such as Inderal
    - Parasympathetic nervous system---The component of the autonomic nervous system that controls vegetative

functions. It is considered an antagonist to the sympathetic nervous system.

a. The neurotransmitter for the parasympathetic nervous system is **acetylcholine**
b. A drug that stimulates the parasympathetic nervous system is known as a **Parasympathomimetic** or **cholinergic** drug. Eg. Prostigmine
c. A drug that blocks or inhibits the parasympathetic nervous system is known as a **Parasympatholytic** or **anticholinergic** drug-----Eg. Atropine

(Section 4, Objective 3) Define the following terms:

a. **Antagonism**
   - Signifies the opposition between 2 or more medications. Eg. Naloxone and morphine

b. **Bolus**
   - Refers to a single, often large dose of a drug. This is generally the initial dose

c. **Cumulative action**
   - This refers to the increased effect of a drug that is caused when a drug is administered in several doses. The increased effect usually results from a buildup of the drug in the blood

d. **Hypersensitivity**
   - A reaction to a drug that is more profound than expected and which is often characterized by an exaggerated immune response

e. **Idiosyncrasy**
   - An individual reaction to a drug that is different from that usually seen

f. **Indication**
   - The medical condition in which the drug has proven to have therapeutic value; the reason the drug is being adminstered

g. **Parenteral**
   - Refers to routes of drug administration other than the digestive tract, Eg. IV, IM or SQ

h. **Pharmacodynamics**

- The study of the mechanisms by which drugs act to produce biochemical or physiological changes in the body

i. **Pharmacokinetics**
   - The study of how drugs enter the body, reach their site of action and are eliminated from the body

j. **Potentiation**
   - The enhancement of one drug's effect by another drug. Eg. Promethazine may enhance the effect of narcotics

k. **Refractory**
   - The failure of a patient or a medical condition to respond as expected to a certain medication. Eg. a patient with PVCs does not respond to lidocaine

l. **Supportive Therapy**
   - A form of therapy designed to maintain the integrity of bodily functions while the patient is recovering. Eg. hydration

m. **Synergism**
   - Refers to the combined action of two drugs that is greater than the sum of the two drugs acting independently

n. **Therapeutic Action**
   - The intended action of a drug given in the appropriate medical setting; the reason that the drug was given

o. **Therapeutic Threshold**
   - The minimum concentration of a drug that is necessary to cause the desired response

p. **Therapeutic Index**
   - The difference between the therapeutic threshold and the level of the drug that is considered toxic (safe and effective range of administration)

q. **Tolerance**
   - This occurs when a patient requires increasingly larger doses of a medication in order to achieve the desired therapeutic effect. Eg. Patient on narcotic analgesics for an extended period of time.

r. **Untoward Effect**
   - A side effect of a drug that is harmful to the patient

***NOTE**: The foregoing material should be considered review for paramedics and should be discussed briefly. The students will take a brief quiz and then review the answers as a group. A copy of a sample quiz follows:*

EXERCISE Complete the Pharmacology Review Quiz:

Section 4 Part II: Pharmocokinetics

This involves a number of steps and concepts that should be understood by the paramedic. Although this section will likely be a review, effort should be made to assure comprehension.

(Section 4, Objective 4) List and define the steps of drug transport in the body to include:

a. **Absorption**-----This is the process by which a drug is transported from its point of entry into the systemic circulation. An important consideration when dealing with absorption is the Rate of Absorption. The Rate is influenced by several important factors:

    1. Solubility of the drug---The greater the solubility, the greater the rate of absorption. A drug that is dissolved in water or an isotonic solution tend to absorb more quickly than a drug dissolved in an oil-based solution. Depending on the circumstances, a slower or faster rate of absorption may be desired.
    2. Concentration--- Drugs administered in high concentrations will absorb more quickly than low concentrations.
    3. pH of the drug-----Most drugs may be classified as either weak acids or weak bases. A drug that is acidic will generally be absorbed rapidly when introduced into the acidic environment of the stomach whereas an alkaline drug will absorb rapidly in the alkaline environment of the kidney.
    4. Site of absorption---- The nature of the site and the quality of the anatomical structures will influence absorption. For example, absorption through the skin is much slower than absorption through mucous membrane.
    5. Surface area--- The larger the surface area, the faster the rate of absorption. Albuterol absorbs very quickly due to the extensive surface area of the pulmonary epithelium.
    6. Blood Supply---- The richer the blood supply to the site, the faster the rate of absorption

b. **Bioavailability**----- Drugs can be deactivated in the process of being transported to their ultimate target tissue. The amount of drug that remains active after it reaches its target is referred to as its bioavailability.

c. **Distribution**--- This is the transport of a drug from the systemic circulation to the site of action. It can be influenced by several factor. The most important of these are cardiovascular function and physiological barriers such as the blood-brain barrier.

d. **Biotransformation**--- Also known as metabolism, this is the process by which drugs are broken down or deactivated into metabolites. In many cases, the metabolite is a less active form of the drug that can be more readily excreted or eliminated from the body. In other cases, such as diazepam, the drug is relatively inactive when administered but is then converted into an active metabolite, which is capable of producing its desired effect. The liver is the most important organ involved in biotransformation.

e. **Excretion/Elimination**--- This is the process by which toxic or inactive metabolites are removed from the body. The kidney is the primary organ of elimination but the lungs, intestines and various glands also play a role. The duration of the excretion process can be useful in determining the amount of a drug to be administered. The slower the rate of excretion, the longer the drug remains in the body.

f. **Half-life**—This is the amount of time it takes for the total amount of the drug in the body to be diminished by one-half.

g. **Two Additional Concepts that should be understood**

- **Mechanism of Action-----**This refers to the manner in which a drug acts to produce its therapeutic effect. The most common mechanism involves receptor interactions.
- **Receptor interactions**---This is the process by which a drug binds to a receptor sites that are protein molecules located on the surface of cells. There are various types of receptor sites named after the type of drug that stimulates it……For example, if stimulated by an opioid, it is called an opioid receptor. The force of attraction between a drug and its receptor is referred to as affinity. When a drug binds to a receptor, a chemical change will occur that eventually leads to the desired therapeutic effect.
  i. Agonists are drugs that bind to a receptor site and cause it to initiate an expected therapeutic response
  ii. Antagonists bind to the site but do not cause an expected

response. Some antagonists such as Naloxone will bind to a receptor site and prevent narcotics from binding to the same site, thereby preventing the narcotic from working. In this case Naloxone has a greater affinity to the receptor site than the narcotic.

(Section 4, Objective 5) List and define the aspects of negative/unexpected drug effects including the following:

a. **Side effects**---These are the undesirable but often predictable effects associated with the administration of drugs. Common side effects include nausea, headache, dizziness and lightheadedness. Eg. Headache that often accompanies use of nitroglycerin.

b. **Untoward Effect**--- These are responses to a drug that actually cause harm to the patient. **Allergic reactions**---These are hypersensitive responses that affect the immune system and which, if not treated promptly and appropriately, may lead to death.

c. **Drug Interactions**—The alteration of the action of one drug by another drug. Some interactions may result in a decreased or increased effect of one or both drugs. In some cases, the interaction between drugs may be desirable. Eg. The interaction between nitroglycerin and anti-impotence drugs such as Viagra, Cialis or Levitra may result in profound hypotension.

d. **Monitoring for negative reactions**
    - The paramedic has the responsibility to continuously monitor for any negative responses to medication and to take appropriate corrective measures.
        1. Monitor vital signs and level of consciousness on a regular basis
        2. Monitor oxygen saturation
        3. Look for signs of hypersensitivity or allergic response
        4. Watch for rhythm changes on the monitor
        5. Carefully watch for therapeutic responses to medication

(Section 4, Objective 5) List and define the aspects of lifespan issues and comorbidity with regard to medication administration to including the following:

a. Life Span Issues and Medication
    - The age of the patient may have a significant impact on the manner in which drugs are prescribed, administered and

handled by the patient.

1. Pediatric Patients
    a) Dosages often have to be altered based on body weight
    b) Immature organs may have difficulty with metabolism and excretion
    c) More susceptible to adverse reactions
2. Geriatric patients
    a) Rate of metabolism and excretion may be altered by age
    b) Drug doses may have to be altered---Some doses may need to be increased while others may need to be decreased
    c) Elderly more likely to be suffering from other medical conditions that may affect drug dosing, metabolism and excretion

b. Considerations related to co-morbidity
    - Various pathological states will alter the manner in which a patient is able to handle certain medications.
    - Renal, hepatic and cardiac disease are the most likely conditions to impact on how a patient deals with drugs
    - Infection, stress, anxiety and depression may also have an effect

(Section 4, Objective 6) EXERCISE Using a case study of a hospitalized patient that includes a drug interaction, life span issue or co-morbid factor, the PIFT paramedic will:

a. Perform a patient assessment and determine eligibility for PIFT transfer.
b. Document criteria used to determine eligibility.
c. Discuss the effect these factors have on transfer decision.
d. Scenario based class discussion
    - Following review of the former section, it would be useful to present scenarios that involve patients being transported on various medications. The focus should be on determining the patient's suitability for transfer, obtaining appropriate drug orders, anticipating potential adverse effects and how to handle problems that may arise during transport.

Section 5 Classifications of Medications

Terminal Objective:

Upon the completion of this section the student will have a basic understanding of the classifications of PIFT medications and their major characteristics.

Enabling Objectives:

Medications are no longer included individually, as in the current PIFT module, but are now included and described by classification.

Enabling Objectives: The student will be able to:

(Section 5, Objective 1) Develop a strategy to accurately recall all the classifications of PIFT medications.

- The MDPB recognizes the following medication classifications for the purposes of PIFT:
    1. Anticoagulants
    2. Anticonvulsants
    3. Antidiabetics
    4. Antidysrhythmics
    5. Antihypertensives (including ACE inhibitors, Calcium Channel Blockers, Diuretics, Alpha Blockers and Beta Blockers)
    6. Anti-infectives
    7. Antipsychotics
    8. Cardiac Glycosides
    9. Corticosteroids
    10. Gastrointestinal Agents (including H2 Blockers, PPI's and Somatostatin and its analogues)
    11. IV Fluids, Electrolytes (including Dextran, Albumin, and Hetastarch)
    12. Drotrecogin
    13. Narcotics (including all routes except epidural)
    14. Parenteral Nutrition
    15. Platelet Aggregation Inhibitors (including IIb/IIIa Inhibitors)
    16. Respiratory Medications (Beta Agonists, Anticholinergics, Mucolytics and Steroids)
    17. Sedatives (Benzodiazepines, Barbiturates)
    18. Vasoactive Agents (Antihypertensives, Pressors/sympathomimetics)

(Section 5, Objective 2) Briefly describe the following aspects of each classification of medication.

1. Generic and trade names
2. Mechanism of action
3. Common indications
4. Contraindications and precautions
5. Significant side effects

6. Adult and pediatric doses
7. Overdose/toxicity signs and symptoms and treatment for same
8. Special considerations

Note: It is not intended that students memorize classification information, but rather, this information should imply be reviewed as an overview. Specific information about a medication or classification of medication should be retrieved from a PIFT resource (see Section 3) and emphasis should be made on utilizing such a resource..

Some General Considerations Regarding Medication

1. Check transfer order and be sure that it contains clear direction regarding the medication to be administered and/or monitored enroute. It should include dosage information, indications and times of administration where appropriate.
2. Check to determine if the medication is one that is permitted under the PIFT module.
3. If you are unfamiliar with the drug, ask the physician to review it with you.
4. Be sure that you understand why the medication was started or is being ordered.
5. Determine the time that it will take to reach the receiving facility and be sure that you have sufficient medication for the trip including an amount to allow for any unanticipated delays due to traffic, weather or other reasons.
6. Check the medication to be sure that you have the correct concentration and that it is not expired.
7. Discuss options with the sending physicians as to how to deal with adverse reactions.
8. If there is an existing IV site, check it for patency, redness, etc.
9. Be sure that you have a drug reference available during transport for further reference.
10. PIFT pre-transfer order check list:

Transfer Order Check List:	
Obtain clear direction regarding medication to be administered and or monitored enroute: Include dosage information,Indications and times of administration	√
Medication permitted under PIFT module	√
Check Medication for correct concentration and expiration date	√
Be sure you understand why medication was started or ordered	√
Ask physician to review unfamiliar drugs with you	√
Discuss options with sending physician to deal with adverse drug rxns	√
Check for patency, redness etc. if existing IV site	√

Section 5 Part I Anticoagulants

- **Common Medications in Class**
  - Heparin

- **Mechanisms of Action**
  - Accelerates formation of antithrombin III
  - interferes with blood coagulation by blocking conversion of prothrombin to thrombin and fibrinogen to fibrin
  - Prevents further extension of existing thrombi or new clot but does not dissolve existing clots.

- **Indications/Uses**
  - Adjunct in treatment of AMI
  - Venous thrombosis
  - Pulmonary embolism
  - DIC (disseminated intravascular coagulation)

- **Contraindications**
  - Active bleeding; known bleeding disorders
  - Severe thrombocytopenia
  - Known sensitivity to the drug

- **Precautions**
  - Be alert for signs of bleeding
  - Monitor vital signs regularly and watch for early signs of shock
  - Use very cautiously in women in late stage of pregnancy

- **Side Effects**
  - Increased bleeding
  - Iitching
  - Confusion
  - Dizziness
  - Irritation and bruising at the injection or IV site

- **Significant Interactions**
  - Should not be given through the same IV line as Amiodarone, dobutamine or diazepam

- **Routes of Administration**
  - IV only during interfacility transport

- Should always be administered by infusion pump

- **Thrombolytics**

  Note: Paramedics will not be permitted to transport patients with thrombolytic medications running. Thrombolytics must be completed at the sending facility prior to transport

- **Common Medications in Class**
  - Alteplase (Activase)
  - Reteplase (Retavase)
  - Streptokinase (Streptase)

- **Mechanism of Action**
  - Catalyzes the conversion of plasminogen to plasmin, thereby facilitating the dissolving of thrombi associated with acute MI and CVAs.

- **Indications/Uses**
  - Treatment of acute MI and CVAs

- **Contraindications**
  - Surgery within the past 2 months
  - Severe hypertension
  - Recent history of CVA
  - Known sensitivity to the drug
  - Recent or current active bleeding
  - Prolonged CPR

- **Precautions**
  - Use with caution in pregnant women and patients over the age of 75

- **Side Effects**
  - Bbleeding (particularly intracranial and GI)
  - Hypotension
  - Arrhythmias
  - Headache
  - Shock

- **Significant Interactions**
  - Use with anticoagulants may increase risk of bleeding

- **Routes of Administration**
  - IV only

- **Dosages**
  - Varies among the different drugs

- **Adverse reactions**
  - During transport the paramedic should be alert for signs of the following:
    - Intracranial, GI or other bleeding
    - Signs of shock
    - Altered level of consciousness
    - Hypotension
    - Arrhythmias

- **Treatment of Adverse Reactions**
  - General supportive measures
  - Treat arrhythmias as per Maine EMS protocols
  - Consider fluids for hypotension
  - Contact medical control for further options including possible diversion

- **Special Considerations**
  - All post-thrombolytic patients should be transported on a cardiac monitor; vital signs should be checked regularly

-
- **Dosages**
  - Normal initial dose may be in the range of 5,000-7,500 units by IV bolus followed by 1,000 units per hour by IV infusion pump
  - Dose may vary based on a number of factors including lab values

- **Overdose/Toxicity Presentation**
  - Signs and symptoms of anaphylaxis
  - Signs of bleeding; look for signs of early shock
  - Nosebleeds

- **Treatment of Overdose/Toxicity**
  - Consider discontinuing drug
  - Follow Maine EMS protocols for allergic reactions
  - Control external bleeding
  - Treat for shock if early signs of shock are present

Section 5 Part II Anticonvulsants

- **Common Medications in Class**

  - Benzodiazepines:
    - lorazepam (Ativan)
    - Diazepam (Valium)
    - Midazolam (Versed)
  - Phenytoin (Dilantin)
  - Fosphenytoin (Cerebyx)
  - Phenobarbital (frequently used in conjunction with phenytoin or fosphenytoin)

- **Mechanism of Action**
  - Benzodiazepines produce an anticonvulsant effect by depressing CNS activity at the limbic and subcortical levels.
  - Phenytoin and Fosphenytoin produce their anticonvulsant effect by stabilizing neuronal membrances in the motor cortex of the brain.
  - Phenobarbital works by depressing CNS activity.

- **Indications/Uses**
  - Treatment or prevention of seizure activity

- **Contraindications**
  - Benzodiazepines: Contraindications include respiratory depression, hypersensitivity to benzodiazepines, shock and severe hypotension.
  - Phenytoin and Fosphenytoin: Contraindications include heart blocks and severe bradycardia since these drugs have antiarrhythmic properties
  - Phenobarbital: Severe CNS depression, severe respiratory disease, known sensitivity to barbiturates

- **Precautions**
  - Use with caution in patients with hypotension; patients on fosphenytoin or phenytoin should be monitored for cardiac arrhythmias; watch for signs of respiratory depression.

- **Side Effects**
  - Phenytoin and fosphenytoin: Side effects include hypotension, headache, dizziness, nausea, vomiting and arrhythmias
  - Benzodiazepines: Side effects include respiratory depression, hypotension and drowsiness
  - Phenobarbital: Drowsiness, hypotension, vertigo, bradycardia, headache and paradoxical excitement

- **Significant Interactions**
  - Use of benzodiazepines or Phenobarbital with other sedatives, barbiturates or depressants may cause increased CNS depression and/or hypotension

  - Use of phenytoin or fosphenytoin with sedatives or tranquilizers may cause severe hypotension; use with antiarrhythmic drugs may cause arrhythmias

- **Routes of Administration**
  - Generally IV but may use other appropriate routes in certain circumstances

- **Dosages**
  - Dosages of anticonvulsants will vary significantly depending on patient condition, age, size and other factors. Discuss dosages with sending physician.

- **Overdose/Toxicity Presentation**
  - May present with hypotension, respiratory depression, vomiting, coma, bradycardia or other cardiac arrhythmias.

- **Treatment of Overdose/Toxicity**
  - Provide general supportive measures; consider IV fluids for hypotension; treat arrhythmias as per Maine EMS protocol; support ventilations as necessary; contact medical control to discuss other options including discontinuing anticonvulsant medication

Section 5 Part III Antidiabetics

- **Common Medications in Class**
  - Insulin
  - Humulin
  - Novolin
  - Novolog,
  - Lletin
  - NPH
  - Lantus

- **Mechanism of Action**
  - Promotes the conversion of glucose to glycogen
  - Promotes uptake of glucose by the cells of the body
  - Reduces and/or maintains blood serum glucose levels

- **Indications/Uses**
  - Elevated glucose levels associated with diabetes
  - Diabetic ketoacidosis
  - Non-ketotic, hyperosmolar coma

- **Contraindications**
  - Hypoglycemia
  - Known sensitivity to the form of insulin being used

- **Precautions**
  - Insulin should not be administered without the capability of monitoring blood glucose at regular intervals.
  - Be prepared to administer dextrose at any time.

- **Side Effects**
  - Itching
  - Swelling
  - Headache
  - Nausea
  - Signs of hypoglycemia

- **Significant Interactions**
  - Use with beta blockers may mask signs of hypoglycemia such as tachycardia
  - When used with corticosteroids, higher doses may be needed as these drugs may increase blood glucose levels

- **Routes of Administration**
  - May be administered by IV infusion or subcutaneous or intramuscular injection

- **Dosage**
  - Infusion rates are generally 0.1 units/kg/hour but rates may vary depending on blood glucose levels
  - Subcutaneous or IM doses are usually in the range of 5 to 20 units

- **Overdose/Toxicity Presentation**
  - Signs and symptoms of allergic reaction
  - Signs and symptoms of hypoglycemia including tachycardia, diaphoresis, nausea, anxiety and diminished level of consciousness

- **Treatment of Overdose/Toxicity**
  - Consider discontinuing insulin
  - Treat allergic reactions or hypoglycemia as per Maine EMS protocols
  - Consult medical control

- **Special Considerations**
  - Monitor patient closely and watch for signs of hypoglycemia
  - Check blood glucose levels on a regular basis during transport

- Have Dextrose available to treat hypoglycemia

Section 5 Part IV Antidysrhythmics

- **Common Medications in Class**

Note: Antidysrhythmics are a very broad classification of medications that include a number of subclassifications. These subclassifications and the more common medications in each subclass include the following:

- Calcium channel blockers
  - Diltiazem (Cardizem)
  - Verapamil (Calan)
  - Nifedipine (Procardia)
- Beta blockers
  - Atenolol (Tenormin)
  - Metoprolol (Lopressor)
  - Propranolol (Inderal)
- Cardiac Glycosides
  - Digoxin (Lanoxin)
  - Digitoxin
- Other Antidysrhythmics include the following:
  - Amiodarone (Cordarone)
  - Lidocaine
  - Magnesium sulfate
  - Phenytoin (Dilantin)
  - Procainamide Pronestyl)

- **Mechanisms of Action**
  - For information on beta blockers and calcium channel blockers, refer to Section 5 Part VI on Antihypertensives; for information on digoxin and digitoxin, refer to Section on Cardiac Glycosides
  - Amiodarone
    - Prolongs action potential in cardiac fibers and depresses conduction velocity
  - Lidocaine
    - Suppresses ventricular ectopic activity; reduces conduction velocity
  - Magnesium sulfate
    - Decreased magnesium levels are associated with cardiac dysrhythmias and cardiac insufficiency
  - Phenytoin
    - Improves atrioventricular conduction
  - Procainamide
    - Decreases myocardial excitability and conduction velocity

- **Indications/Uses**
  Note: Antidysrhythmics are used to treat a wide variety of cardiac dysrhythmias.
  - **Calcium channel blockers**, **beta blockers** and **digoxin** may all be used to treat atrial fibrillation, atrial flutter and other tachyarrhythmias
  - **Lidocaine** is typically used to treat wide complex tachycardias and ventricular ectopy
  - **Amiodarone** generally used for atrial and ventricular tachyarrhythmias
  - **Magnesium sulfate** may be used for refractory VF, torsades de pointes with a pulse and ventricular arrhythmias due to digitalis toxicity
  - **Procainamide** is used for a wide variety of tachyarrhythmias; often a secondary drug
  - **Phenytoin** is often used to treat life-threatening arrhythmias resulting from digital toxicity or other causes

- **Contraindications**
  - All drugs are contraindicated with known sensitivity to the drug to be administered.
  - Lidocaine
    - 2nd and 3rd degree heart blocks
  - Amiodarone
    - No contraindications in cardiac arrest; significant bradycardia and cardiogenic shock in other cases
  - Procainamide
    - 3rd degree heart block, prolonged QT interval, digitalis toxicity
  - Phenytoin
    - Heart blocks, bradycardia and Stokes-Adams syndrome (altered state of consciousness caused by diminished blood flow to the brain)
  - Calcium channel blockers and beta blockers
    - Bradycardia and hypotension; heart blocks

- **Precautions**
  - All antidysrhythmics should be used with caution and all patients should be on the cardiac monitor throughout transport. Be alert for changes in rhythms and vital signs; watch for hypotension and changes in level of consciousness. Consult drug reference book for more detailed information.

- **Side Effects**
  - Headache, dizziness

  - Arrhythmias
  - Hypotension
  - Nausea
  - Altered levels of consciousness
  - Weakness

- **Significant Interactions**
  - Antidysrhythmics must be used with great caution when used together with other antidysrhythmics. Use together increases the chances of developing adverse reactions such as bradycardia, hypotension, arrhythmias and seizures. Paramedics must be alert for any such occurrences. See drug reference book for further information regarding drug interactions.

- **Routes of Administration**
  - Most antidysrhythmics will be administered by IV but IM or PO routes may be appropriate in certain circumstances.

- **Dosages**
  - Dosages of these drugs will vary considerably based on the patient's status, age, weight and other factors. Consult with sending physician to confirm dose and refer to drug reference book for more detailed information.

- **Overdose/Toxicity Presentation**
  - The most significant reactions to be aware of are the following:
    - Arrhythmias
    - Altered levels of consciousness
    - Hypotension and/or bradycardia
    - Seizures
    - Allergic reactions

- **Treatment of Overdose/Toxicity**
  - General supportive measures
  - Treat arrhythmia, seizures and allergic reactions as per Maine EMS protocols
  - Consider fluids for hypotension
  - Contact medical control for options of discontinuing or decreasing drug dose or for diversion to closest hospital

- **Special Consideration**
  - Transfer all patients on cardiac monitor and be alert for changes; monitor vital signs frequently

Section 5 Part V Antihypertensives

- Note: The class of drugs known as antihypertensives contains the following subclasses:
  - ACE Inhibitors
  - Alpha Blockers
  - Beta Blockers
  - Calcium Channel Blockers
  - Diuretics
  - Vasodilators

- **Common Medications in Class**
  - **ACE Inhibitors:**
    - Benazepril (Lotensin)
    - Captopril (Capoten)
    - Enalapril (Vasotec)
    - Lisinopril (Zestril)
    - Ramipril (Altace)
  - **Alpha Blockers:**
    - Doxazosin (Cardura)
    - Prazosin (Minipress)
    - Terazosin (Hytrin)
  - **Beta Blockers:**
    - Atenolol (Tenormin)
    - Labetalol (Normodyne)
    - Metoprolol (Lopressor)
    - Nadolol (Corgard)
    - Propranolol (Inderal)
  - **Calcium Channel Blockers:**
    - Amlodipine (Norvasc)
    - Diltiazem (Cardizem)
    - Nifedipine (Procardia)
    - Verapamil (Calan)
  - **Diuretics:**
    - Furosemide (Lasix)
    - Bumetanide (Bumex)
    - Torsemide (Demadex)
    - Hydrochlorothiazide (HydroDiuril), amiloride (Midamor)
  - **Vasodilators:**
    - Hydralazine (Apresoline)
    - Minoxidil (Loniten)

- **Mechanisms of Action**
  - **ACE Inhibitors:**
    - Prevent the hormone angiotensin I from converting to angiotensin II, a potent vasoconstrictor.

        - In preventing this conversion, ACE inhibitors relax blood vessels and help reduce blood pressure.
    - **Alpha Blockers:**
        - Block alpha-1 adrenergic receptors resulting in a decrease in systemic vascular resistance and a corresponding decrease in blood pressure
    - **Beta Blockers:**
        - Decrease heart rate, blood pressure and cardiac output by blocking adrenergic receptors
        - Decrease the influence of the sympathetic nervous system
    - **Calcium Channel Blockers:**
        - Inhibits the entry of calcium into cardiac and vascular smooth muscle cells, thereby causing relaxation and dilation of the vessels and a corresponding decrease in blood pressure
    - **Diuretics:**
        - Promote the excretion of water and electrolytes
        - Reduces peripheral vascular resistance and blood pressure
    - **Vasodilators:**
        - Work by exerting a relaxing, vasodilatory effect on vascular smooth muscle

- **Indications/Uses**
    - Hypertensive crisis
    - Certain of these medications also have antiarrhythmic properties and may be used to treat various arrhythmias
        - See Section on Antiarrhythmic medications for further information

- **Contraindications**
    - Hypersensitivity to the drug
    - Hypotension
    - Bradycardia
    - 2nd and 3rd degree heart blocks

- **Precautions**
    - All hypertensive agents should be used cautiously in patients with cardiovascular disease, heart blocks, renal failure and bradycardia

- **Side Effects**
    - **Calcium Channel Blockers, Alpha Blockers and Beta Blockers:**
        - Common side effects include:
            - Headache
            - Bradycardia
            - Hypotension
            - Nausea

        - Fatigue
        - Weakness
        - Wheezing
    - **ACE Inhibitors**:
        - Side effects may include:
            - Headache
            - Nausea
            - Cough
            - Postural hypotension
            - Dizziness
    - **Diuretics:**
        - Dizziness
        - Nausea/vomiting
        - Hypotension
        - Heart block
        - Dry mouth
        - Weakness
    - **Vasodilators:**
        - Headache
        - Nausea
        - Tachycardia
        - Hypotension
        - Weakness

- **Significant Interactions**
    - Use of any antihypertensive agent with other antihypertensives, sedatives or narcotics may result in profound hypotension

- **Routes of Administration**
    - IV
    - IM
    - PO

- **Dosages**
    - Dosages will vary significantly based on the drug being used and the medical status, age and size of the patient.
    - Confirm dose with sending physician or RN.

- **Overdose/Toxicity Presentation**
    - Most significant adverse reactions involve exaggeration of common side effects and include the following:
        - Severe hypotension
        - Symptomatic bradycardia
        - Arrhythmias

- **Treatment of Overdose/Toxicity**

- General Supportive care
- Consider fluids for hypotension but be alert for signs of pulmonary edema
- Consider discontinuation of drug or reduction in dose
  - Contact medical control for options and/or consult transfer order
- Follow Maine EMS protocols for bradycardia or other arrhythmias

- **Special Considerations**
  - Monitor vitals frequently and place patient on cardiac monitor during transport

Section 5 Part VI Anti-Infectives Including Antivirals and Antifungals

- **Common Medications in Class**
  - Antibiotics
    - Penicillin preparations
    - Aminoglycosides such as:
      - Tobramycin
      - Gentamicin
      - Vancomycin
    - Cephalosporins such as:
      - Cefazolin (Ancef)
      - Ceftazidime (Fortaz)
      - Ceftriaxone (Cefizox)
  - Antivirals
    - Acyclovir
    - Famciclovir and Foscarnet (rarely used in interfacility transport)
  - Antifungals
    - Amphotericin B is the most common (should not be administered in the field)

- **Mechanism of Action**
  - Anti-Infective medications are natural or synthetic substances that either inhibit the growth of or destroy disease-causing microorganisms.

- **Indications/Uses**
  - Used to treat a wide variety of infectious diseases

- **Contraindications**

  - Known hypersensitivity to the medication or to another medication in the same class.

- **Precautions**
  - Be alert for signs and symptoms of hypersensitivity/allergic reaction.
    - Anti-Infective drugs should always be started in the hospital to determine if the patient is sensitive to the drug
  - Be prepared to treat for allergic reactions.

- **Side Effects**
  - Most common side effects associated with anti-infective drugs are the following:
    - Rash, pruritis
    - Induration at IV site
    - Itching, burning
    - Tearing eyes
    - Nausea
    - Headache

- **Significant Interactions**
  - Some anti-infectives may interact with other medications to produce negative effects that may include decreased efficacy or an increased potential for nephrotoxicity or other serious conditions.
  - Discuss potential interaction problems with the sending facility.

- **Routes of Administration**
  - Generally IV but may also use IO or PO

- **Dosages**
  - Dosages for anti-infective drugs will vary greatly based on the patient's condition.
  - Discuss dosage and dosing schedule with sending physician.

- **Toxicity/Overdose Presentation**
  - Most likely adverse reactions will manifest themselves as hypersensitivity/allergic reaction presentations.
  - Watch for the typical signs and symptoms of an allergic reaction.

- **Treatment of Toxicity/Overdose**
  - Discontinue anti-Infective drug
  - Follow Maine EMS protocols for treatment of allergic reactions.
    - Consider diphenhydramine (Benadryl) and/or epinephrine.

Section 5 Part VII Antipsychotics

- **Common Medications in Class**
  - There are now an extensive number of antipsychotic medications available. Those most likely to be used in the context of an interfacility transfer are as follows:
    - Haloperidol (Haldol)
    - Risperidone (Risperdal)
    - Droperidol (Inapsine)
    - Aripiprazole (Abilify)
    - Chlorpromazine (Thorazine)
    - Clozapine (Clozaril)
    - Benzodiazepines:
      - Diazepam
      - Lorazepam

- **Mechanisms of Action**
  - Haloperidol and Chlorpromazine:
    - Reduce psychotic manifestations by blocking CNS dopamine receptors
  - Droperidol:
    - Produces sedation by blocking subcortical receptors
  - Risperidone, Aripiprazole and Clozapine:
    - Suppresses psychotic behavior by reducing abnormal excitement in the brain
  - Benzodiazepines:
    - Act by depressing CNS activity
      - See Section on Anticonvulsants

- **Indications/Uses**
  - Treatment and management of psychotic behavior
  - Chemical restraint

- **Contraindications**
  - Hypersensitivity to the drug
  - Shock
  - Respiratory depression
  - Do not use Droperidol in presence of known or suspected prolonged QT interval (Black Box status)

- **Precautions**
  - Haloperidol should be used with caution in patients taking lithium or anticoagulation therapy
  - Diphenhydramine (Benadryl) should be available if dystonic or extrapyramidal reactions occur

- **Side Effects**

  - Haloperidol, Droperidol and Chlorpromazine:
    - Sedation
    - Hypotension
    - Drowsiness
    - Dizziness
  - Benzodiazepines:
    - In addition to the above, may cause respiratory depression
  - Risperidone:
    - Headache
    - Anxiety
    - Agitation
  - Aripiprazole:
    - Headache
    - Insomnia
    - Nausea/vomiting

- **Significant Interactions**
  - Use of sedatives or tranquilizers may result in severe CNS and/or respiratory depression

- **Routes of Administration**
  - Depending on drug
    - IV
    - IM
    - PO
- **Dosages**
  - Dosages will vary significantly based on the drug being used, the medical status, age and size of the patient.
  - Confirm dose with sending physician or RN.

- **Overdose/Toxicity Presentation**
  - Significant reactions include the following:
    - Respiratory
    - CNS depression
    - Hypotension
    - Seizures
    - Extrapyramidal reaction
      - May be characterized by:
        - Agitation
        - Muscle spasm
        - Tremors
        - Drooling

- **Treatment of Overdose/Toxicity**
  - General supportive measures
  - Support ventilations as necessary

        - Be prepared to intubate
        - onsider fluids for hypotension
    - Follow Maine EMS protocols for seizures
    - Consider diphenhydramine for extrapyramidal reactions

Section 5 Part VIII Cardiac Glycosides

- **Common Medications in Class**
    - Digoxin (Lanoxin)

- **Mechanism of Action**
    - Potentiates the activity of the contractile heart muscle and increases the force of contraction
    - Slows conduction through the SA and AV nodes

- **Indications/Uses**
    - Atrial fibrillation and atrial flutter; management of CHF; atrial tachycardias

- **Contraindications**
    - Ventricular fibrillation
    - History of sensitivity to digitalis preparations

- **Precautions**
    - Use with caution in patients with acute MI
    - Second and third degree heart blocks
    - Renal failure

- **Side Effects**
    - Headache
    - Confusion
    - Vertigo
    - Anxiety
    - Vomiting
    - Cardiac side effects may include:
        - Hypotension
        - Heart blocks
        - Bradycardia or tachycardia.

- **Significant Interactions**
    - Beta blockers can cause symptomatic bradycardias
    - Use with loop diuretics such as furosemide or calcium channel blockers may increase risk of digitalis toxicity

- **Routes of Administration**

- IV only during transport

- **Dosages**
  - Dosing may vary depending upon patient presentation, size and age
  - Typical initial dosing for adults may be 0.25 to 1.0 mg IV push
  - Pediatric: Very rarely used for pediatric patients in the field

- **Overdose/Toxicity Presentation**
  - Cardiac disturbances including arrhythmias such as heart blocks, ventricular fibrillation and asystole
  - Vomiting

- **Treatment of Overdose/Toxicity**
  - Administer oxygen and maintain airway
  - Treat any cardiac arrhythmias according to Maine EMS protocols
  - Consider discontinuation of drug
  - Provide general supportive measures
  - Consider diversion for complications for refractory to treatment in the field
  - Contact medical control for further options

- **Special Considerations**
  - All patients on cardiac glycosides should be transported on a cardiac monitor and watched closely

Section 5 Part IX Corticosteroids

- **Common Medications in Class**
  - Betamethasone (Celestone)
  - Dexamethasone (Decadron)
  - Hydrocortisone (Solu-Cortef)
  - Methylprednisolone (Solu-Medrol)
  - *Corticosteroids in Inhalation form:*
    - Beclomethasone (Beclovent, Beconase)
    - Flunisolide (AeroBid, Nasalide)
    - Triamcinolone (Azmacort, Kenalog)

- **Mechanisms of Action**
  - Suppresses and/or inhibits the accumulation of inflammatory cells at inflammation sites; suppresses the immune system by binding to intracellular corticosteroid receptors; suppresses immune response in allergic reactions

- **Indications/Uses**

  - Common uses include the following:
    - Cerebral edema associated with head injury
    - Suppress the immune system in anaphylactic shock/severe allergic reaction
    - Status asthmaticus
    - Treatment of chronic inflammatory conditions

- **Contraindications**
  - Known hypersensitivity to corticosteroid medications
  - Serious systemic infections

- **Precautions**
  - Use with caution in patients with CHF, hypertension or history of recent seizures.

- **Side Effects**
  - Common side effects include the following:
    - Headache, edema, hypertension, dizziness, nausea, vomiting, cough, facial swelling

- **Significant Interactions**
  - May decrease the effect of insulin, diuretics or potassium supplementation; may increase potential for digoxin toxicity

- **Routes of administration**
  - Generally IV but may also be administered by any appropriate route including inhalation.

- **Dosages**
  - Dosages will vary considerably based on the type of medication and the condition, age, weight and history of the patient. Discuss dosing information carefully with the sending physician.

- **Toxicity/Overdose Presentation**
  - Toxicity is rare but when it occurs, it usually consists of an exaggeration of side effects such as hypertension, nausea/vomiting, headache, edema or CHF

- **Treatment of Toxicity/overdose**
  - Contact medical control and consider discontinuing drug; monitor vitals and use general supportive measures; follow Maine EMS protocols for CHF or nausea/vomiting

Section 5 Part X Gastrointestinal Agents Including H2-Blockers, PPI's and Somatostatin and its analogues

- N*ote: Section 5 part X includes several classifications of medications including:*
  - H_2 Blockers
    - Famotidine (Pepcid)
    - Cimetidine (Tagamet)
  - Protein Pump Inhibitors
    - Pantoprazole (Protonix)
    - Lansoprazole (Prevacid)
  - Somatostatin Analogues
    - Octreotide (Sandostatin)

- **Mechanisms of Action**
  - H_2 Blockers
    - Decreases gastric secretion by inhibiting histamine action at H_2 receptors
  - Protein Pump Inhibitors
    - Inhibits the last enzyme in the enzymatic cascade for secretion of hydrochloric acid in the parietal cell; increases gastric pH
  - Somatostatin Analogues
    - Enhances fluid/electrolyte absorption from GI tract
    - Inhibits gall bladder contractility and suppresses TSH (thyroid stimulating hormone)

- **Indications/Uses**
  - H_2 Blockers
    - Active duodenal ulcer
    - Active benign gastric ulcer
    - GERD
    - Pathological hypersecretory syndromes such as Zollinger-Ellison syndrome
    - Upper GI bleeding without good control
  - Protein Pump Inhibitors
    - Erosive esophagitis
    - Upper GI bleed with uncertain etiology
    - Pathological hypersecretory syndromes such as Zollinger-Ellison syndrome
  - Somatostatin Analogues
    - Esophageal varices that are bleeding
    - Carconoid tumors and vasoactive intestinal peptide tumors (Vipomas)

- **Contraindications**
  - Hypersensitivity to any of these drugs or their components

- **Precautions**
  - Octreotide has the potential to impact significantly on serum glucose levels and cardiac conduction. All patients on these medications should be on a cardiac monitor and blood glucose should be checked regularly.

- **Side Effects**
  - Diarrhea, nausea, vomiting, headache, constipation, dizziness, arrhythmias

- **Significant Interactions**
  - There are no significant interactions with these drugs that are of concern during interfacility transport.

- **Routes of Administration**
  - These drugs are all administered by IV bolus or infusion; other GI drugs not referred to herein may be administered by other routes such as PO

- **Dosages**
  - Famotidine
    - Adult dose is 20 mg IV every 12 hours and pediatric dose is 0.25 mg/kg every 12 hours up to the adult dose for those over 1 year of age.
  - Pantoprazole
    - Adult dose is 40 mg IV once daily for upper GI bleed and 80 mg IV twice daily for hypersecretory conditions. Administer reconstituted formula through in-line filter in dedicated line. 40 mg should be reconstituted in 100 cc of normal saline and then further dilution with 100 cc of D_5W, normal saline or LR to a final concentration of approximately 0.4 mg/ml. Administer over 15 minutes at a rate not greater than 3 mg/minute (7 cc/minute)
  - Octreotide
    - Most commonly used in emergency medicine for variceal bleeding. Give 50 mcg IV bolus followed by 25 mcg/hr by IV drip

- **Overdose/Toxicity Presentation**
  - Adverse reactions to famotidine or pantoprazole are rare but there is the potential for allergic reactions.

- Octreotide may cause alterations in blood glucose levels or rhythm changes.

- **Treatment of Overdose/Toxicity**
  - Provide general supportive care
  - Follow Maine EMS protocols for hypoglycemia or arrhythmias
  - Contact medical control for other options

Section 5 Part XI Intravenous Fluids and Electrolytes Including Dextran and Hetastarch

- **Common Fluids in Class**
  - Normal saline (crystalloid solution)
  - ½ normal saline (crystalloid solution)
  - Lactated Ringers solution (crystalloid solution)
  - 5% dextrose in water (D5W)
  - 10% dextrose in water (D10W)
  - Dextran
  - Plasmanate
  - Hetastarch
  - Albumin

- **Mechanisms of Action**
  - Normal saline, ½ Normal saline and Lactated Ringers
    - Act by replacing water and electrolytes.
  - D5W and D10W
    - Act by replacing water and dextrose.
  - Dextran
    - Acts as a plasma volume expander
    - Its large molecules keep it within the intravascular space.
  - Plasmanate
    - Supplies colloid to the blood and causes a shift of fluid from the interstitial space into the systemic circulation
  - Hetastarch
    - Exerts an osmotic pull on tissue fluids and thereby increases circulatory volume
  - Albumin
    - Provides a temporary increase in blood volume

- **Indications/Uses**
  - IV fluids are primarily used for hypovolemia, shock, fluid replacement in dehydration, burns
  - D5W is primarily used to establish a line for certain medications
  - D10W can be used for hypoglycemia and neonatal resuscitation
  - Plasmanate may also be used to treat hypoproteinemia

- **Contraindications**
  - Known hypersensitivity to any solution
  - D5W, D10W and ½ normal saline are contraindicated when rapid fluid volume replacement is needed
  - Dextran, Albumin and Hetastarch are contraindicated in CHF and pulmonary edema

- **Precautions**
  - All patients should be monitored carefully to be alert for signs of circulatory overload, CHF or pulmonary edema.
- **Side Effects**
  - Common side effects include:
    - CHF
    - Circulatory overload and edema.
    - Other side effects such as rah, nausea, vomiting, headaches and chills are sometimes seen with Hetastarch, Dextran and Plasmanate

- **Significant Interactions**
  - D5W and D10W are incompatible with phenytoin (Dilantin)
  - Dextran and Hetastarch should not be used with heparin or coumadin

- **Route of Administration**
  - IV
  - IO

- **Dosages**
  - Dosages of al IV fluids will vary significantly based on the fluid being administered and patient's medical condition, age and weight.
  - Discuss dosages with sending physician

- **Overdose/Toxicity Presentation**
  - Few toxic effects are seen as a result of IV fluid administration.
  - Be alert for signs of fluid overload, CHF and/or pulmonary edema.

- **Treatment of Overdose/Toxicity**
  - Treat CHF/pulmonary edema as per Maine EMS protocols
  - Consider discontinuing fluid or reducing rate of infusion

- **Electrolytes**

- **Common Medications in Class**

- Potassium
- Calcium preparations (calcium chloride, calcium citrate, calcium carbonate)
- Sodium chloride
- Sodium bicarbonate (also an alkalizing agent)

- **Mechanisms of Action**
  - Potassium
    - Readily absorbed through the GI tract to provide supplementation in cases of potassium deficiency
    - Potassium is necessary for nerve impulse conduction and contraction of cardiac, skeletal and smooth muscle
  - Calcium preparations
    - Replace calcium in cases of hypocalcemia.
    - Absorption takes place in the small intestine.
  - Sodium Bicarbonate
    - Acts as a buffer to restore normal pH
    - Also neutralizes excess buildup of acids
  - Sodium chloride
    - Absorbed through the GI tract and replenishes sodium and chloride deficiencies

- **Indications/Uses**
  - Potassium
    - Used to treat potassium loss and deficiency when oral replacement is not feasible
    - Severe loss of GI secretions due to vomiting or diarrhea
    - Diabetic acidosis
  - Calcium preparations
    - Used to treat hypocalcemia and acute cases of hyperkalemia (elevated potassium)
    - Calcium channel blocker toxicity
  - Sodium chloride
    - Used to restore sodium and chloride depletion
    - Extracellular fluid replacement.
    - For further information on sodium preparations, see Section on IV fluids
  - Sodium bicarbonate
    - Used to treat hyperacidity
    - Sever diarrhea where there is loss of bicarbonate
    - Treatment of metabolic acidosis due to shock, dehydration or anoxia
    - Alkalization of urine in certain cases of drug toxicity

- **Contraindications**

  - Potassium is contraindicated in cases of severe renal impairment
  - Calcium is contraindicated in hypercalcemia, ventricular fibrillation and digoxin toxicity
  - Sodium bicarbonate should not be used in cases of known alkalosis

- **Precautions**
  - Potassium should be administered with caution in the presence of known cardiac or renal disease
  - Calcium chloride can cause local tissue necrosis. Be sure that IV line is patent.

- **Side Effects**
  - Potassium:
    - Dysrhythmias
    - Heart blocks
    - Nausea/vomiting
    - Diarrhea
    - Abdominal discomfort
  - Calcium:
    - Nausea/vomiting
    - Bradycardia
  - Sodium chloride:
    - Circulatory overload
    - Nauseaeadache
  - Sodium bicarbonate:
    - Alkalosis
    - Muscle cramping

- **Significant Interactions**
  - Potassium is not compatible with diazepam if given in the same line
  - Calcium chloride and sodium bicarbonate should not be administered through the same line

- **Routes of Administration**
  - IV

- **Dosages**
  - Dosages of all drugs in this class are highly individualized and will vary based on patient need, size and age.
  - Normal dose for potassium replacement is 40mEq/L given at a maximum rate of 20mEq/hour

- **Overdose/Toxicity Presentation**
  - Potassium:
    - Hyperkalemia

        - Arrhythmias
    - Sodium Bicarbonate:
        - Seizures
        - Arrhythmias
        - Metabolic alkalosis

- **Treatment of Overdose/Toxicity**
    - General supportive measures
    - Treat arrhythmias and seizures as per Maine EMS protocols
    - Consider discontinuation of drug or reduction of dosage
    - Contact medical control for options

- **Special Considerations**
    - Transport all patients on cardiac monitor and check vitals frequently

Section 5 Part XII Drotrecogin

- **Class**
    - Activated protein; antisepsis agent

- **Mechanism of Action**
    - Possesses antithrombic, anti-inflammatory and profibrinolytic effects; interferes with some of the body's harmful responses to severe infection, including the formation of blood clots that can lead to organ failure and death

- **Indications/uses**
    - Treatment of severe sepsis or septic shock with evidence of organ dysfunction

- **Contraindications**
    - Active internal bleeding
    - Recent hemorrhagic stroke
    - Recent intracranial surgery (within 3 months)
    - Severe head injury with risk of bleeding

- **Precautions**
    - Watch patient carefully for signs of bleeding

- **Side Effects**
    - None known

- **Significant Interactions**
    - None known

- **Routes of Administration**
  - IV only

- **Dosages**
  - Normal infusion rate is 24 mcg/kg/hour but rate may vary. Discuss rate with sending physician.
  - Drotrecogin comes as a powder that must be reconstituted with sterile water prior to use.

- **Overdose/Toxicity Presentation**
  - Toxic effects are rare; most significant toxic effect consists of internal bleeding

- **Treatment of Overdose/Toxicity**
  - Treat for shock and contact medical control for option of discontinuing drug

- **Special Considerations**
  - Monitor vitals frequently

Section 5 Part XIII Narcotics Including All Routes Except Epidural

- **Common medications in class**:
  - Morphine sulfate
  - Fentanyl (Sublimaze)
  - Hydromorphone (Dilaudid)
  - Meperidine (Demerol)
  - Pentazocine (Talwin)
  - Butorphanol (Stadol)

- **Mechanism of Action**
  - Binds to opiate receptor sites to produce a strong analgesic effect

- **Indications/Uses**
  - Used primarily for the relief of moderate to severe pain; may be used as an adjunctive medication to prepare patients for cardioversion

- **Contraindications**
  - History of hypersensitivity to the drug
  - Hypotension
  - Head injury

- Undiagnosed abdominal pain is not generally a contraindication during interfacility transfer

- **Precautions**
  - Watch closely for respiratory depression
  - Monitor vital signs
  - Use cautiously in pregnant patients, children and the elderly

- **Side Effects**
  - Nausea/vomiting
  - Respiratory depression
  - Euphoria
  - Dizziness
  - Bradycardia
  - Hypotension

- **Significant Interactions**
  - Use with other narcotic agents, benzodiazepines or antihistamines may cause profound CNS depression including respiratory depression or arrest

- **Routes of Administration**
  - May use all appropriate routes except epidural

- **Dosages**
  - Morphine Sulfate
    - *Adult*: Initial dose is generally 2-5 mgs supplemented by additional doses of 2mg every few minutes until the desired result is achieved or respiratory depression occurs.
    - *Pediatric:* Usual dose is 0.1 to 0.2 mg/kg
  - Fentanyl (Sublimaze)
    - *Adult:* Usual bolus dose is 25-50 mcg administered IV push; may repeat every 10-15 minutes. Maximum dose is generally 200 mcg/24 hours.
    - *Pediatric:* 1-2 mcg/kg
  - Hydromorphone (Dilaudid)
    - *Adult:* 1-4 mg every 4-6 hours for moderate to severe pain
    - *Pediatric:* Rarely used in children under 50kg
  - Meperidine (Demerol)
    - *Adult:* Initial dose of 25-50 mg Infusion rate is generally 15-35 mg/hour
    - *Pediatric:* 1.1-1.3 mg/kg every 3-4 hours
  - Pentazocine (Talwin)
    - *Adult:* 20-30 mg every 3-4 hours
    - *Pediatric:* Rarely used in children under the age of 12

  - Butorphanol (Stadol)
    - *Adult:* 0.5-2.0 mg every 3-4 hours when administered IV 1-4 mg every 3-4 hours when administered IM
    - *Pediatric:* Rarely used in pediatric patients

Note: Infusion rates for narcotic analgesics, for both adult and pediatric patients, may vary greatly depending on patient condition, age, weight, medical history and history with the drug.

- **Overdose/Toxicity Presentation**
  - Signs and symptoms of overdose/toxicity may include any of the following:
    - Respiratory and/or CNS depression
    - Apnea
    - Miosis
    - Bradycardia
    - Hypotension

- **Treatment of Overdose/Toxicity**
  - Consider the following interventions:
    - Monitor ABCs
    - Assist ventilations as necessary and be prepared to intubate
    - Treat arrhythmias as per Maine protocols
    - Discontinuation of medication or reduction in dosage
    - Administration of Naloxone (0.4-2.0 mg)
    - Contact medical control for additional options

- **Special Considerations**
  - Always have Naloxone and intubation equipment readily available.

Section 5 Part XIV Parenteral Nutrition

- **Common Medications in Class**
  - Total Parenteral Nutrition
  - Vitamins

- **Mechanism of Action**
  - These supplements are used to provide specialized sources of nutrition and other elements to patients unable to take nutrition orally or who have nutritional deficiencies.
  - TPN is traditionally supplied in either a 2:1 or 3:1 mixture. The 2:1 mixture contains dextrose and protein/amino acid solutions. The 3:1 mixture will contain these elements plus a lipid mixture. The 2:1 mixture is generally clear while the 3:1 mixture is cloudy. TPN may also include vitamins, electrolytes, acid blockers and insulin.

  - Vitamin infusions may consist of a multi-vitamin mixture or individual vitamins depending on the needs of the individual patient.

- **Indications/Uses**
  - In patients requiring nutritional needs but who are unable to take food or fluids by mouth
  - To prevent or treat vitamin deficiencies in patients with inadequate diets or increased daily requirements

- **Contraindications**
  - None except hypersensitivity to the mixture or its components

- **Precautions**
  - All patients who receive insulin as part of their TPN solution should be monitored for blood glucose levels on a regular basis. Also, since most of these solutions are delivered through a central venous access device, the device should be monitored closely for signs of problems. Watch for signs of toxicity from Vitamins A and D.

- **Side Effects**
  - Possible allergic reactions in patients with sensitivity
  - hypoglycemia

- **Significant Interactions**
  - None

- **Route of Administration**
  - IV only; TPN is generally administered through a central venous access device

- **Dosages**
  - TPN is usually administered in an amount based on patient weight.
  - Vitamins are administered in various amounts based on the nature and severity of the deficiency

- **Overdose/Toxicity Presentation**
  - Adverse reactions are rare but may present as allergic reactions or as hypoglycemia.

- **Treatment of Overdose/Toxicity**
  - Allergic reactions
    - Follow Maine EMS protocol and consider administration of diphenhydramine and/or epinephrine.
  - Hypoglycemia: Follow Maine EMS protocols and consider Dextrose 50% or Glucagon

Section 5 Part XV Platelet Aggregation Inhibitors Including Glycoprotein IIb/IIIa Inhibitors

- **Common Medications in Class**
  - Abciximab (ReoPro)
  - Eptifibatide (Integrelin)
  - Tirofiban (Aggrastat)

- **Mechanism of Action**
  - These medications inhibit fibrinogen binding to platelets, thereby inhibiting platelet aggregation. Platelet aggregation is reversible following termination of the administration of the drug.

- **Indications/Uses**
  - Used to inhibit platelet function in patients with coronary artery disease. Commonly used in combination with Heparin for patients with acute coronary syndrome, including those patients who are to be managed either medically or undergoing PTCA (percutaneous transluminal coronary angioplasty) or artherectomy.

- **Contraindications**
  - Known hypersensitivity to any component of the medication
  - Active bleeding or history of bleeding diathesis within the prior 30 days
  - History of intracranial hemorrhage, intracranial neoplasm, AV malformation or aneurysm.
  - History of thrombocytopenia following prior exposure to the drug
  - Major surgical procedure or severe physical trauma within prior 30 days
  - History of symptoms or findings suggestive or aortic dissection.
  - Severe hypertension (SBP > 180mm and/or DBP > 110mm)
  - Acute pericarditis
  - Concomitant use of another IIb/IIIa inhibitor
  - History of CVA within 30 days or any history of hemorrhagic CVA

- **Precautions**
  - Monitor closely for any signs of bleeding
  - Avoid any unnecessary IV sticks
  - Monitor for signs and symptoms of anaphylaxis

- **Side Effects**
  - Bleeding, bradycardia, headache, leg or pelvis pain, dizziness, nausea, fever

- **Significant Interactions**
  - Use very carefully with anticoagulants such as warfarin (Coumadin), clopidogrel, heparin and thrombolytics since the risk of bleeding will be increased when used with these medications

- **Route of Administration**
  - IV only

- **Dosages and Administration**
  - Dosages vary significantly among the various drugs in this class and will be determined by the sending physician
  - A two-staged IV infusion is commonly used for administration
  - IIb/IIIa inhibitors have a half-life of approximately 2 hours
  - No filter is needed for infusion; Heparin may be used at the same IV site

- **Overdose/Toxicity Presentation**
  - Most important consideration is to be alert for signs and symptoms of bleeding, either internally or externally at puncture sites.
  - Internal bleeding may be accompanied by signs and symptoms of shock, nausea or changes in level of consciousness.

- **Treatment of Overdose/Toxicity**
  - Contact sending physician or medical control
  - Consider discontinuing medication or reducing dose
  - Consider discontinuing or reducing dose of heparin if being used in conjunction with IIb/IIIa inhibitor
  - Control any external bleeding
  - Treat for shock
  - Treat arrhythmias as per Maine protocol
  - Consider diversion to nearest facility

Section 5 Part XVI Respiratory Medications Including Beta Agonists, Anticholinergics, Mucolytics and Steroids

- **Subclasses of Medications Included**
  - Beta agonists
  - Anticholinergics
  - Steroids
  - Mucolytics

- **Common Medications in each Subclass**
  - Beta Agonists

        - Albuterol (Proventil, Ventolin)
        - Metaproterenol (Alupent, Meteprel)
        - Piruterol (Maxair)
        - Salmeterol (Serevent)
        - Terbutaline (Brethine)
    - Anticholinergics:
        - Ipratropium (Atrovent)
    - Steroids:
        - Beclomethasone (Beclovent, Vanceril)
        - Budesonide (Pulmicort)
        - Cromolyn (Intal)
        - Flunisolide (AeroBid)
        - Fluticasone (Flovent)
        - Triamcinolone (Azmacort)
    - Mucolytics:
        - Acetylcysteine (Mucomyst)
    - Miscellaneous:
        - Montelukast (Singulair) (Classified as a leukotriene modifier)
        - Aminophylline
    - Also, see section on Corticosteroids

- **Mechanisms of Action**
    - Beta Agonists
        - Provide bronchodilation for relief of bronchospasm associated with asthma and reversible obstructive airway disease
    - Anticholinergics
        - Provide long term maintenance of bronchodilation; not used for emergency relief
    - Steroids
        - Reduce inflammation and produce smooth muscle relaxation in the airways; decrease mucus secretion
    - Mucolytics
        - Reduces viscosity of pulmonary secretions
    - Leukotriene modifier
        - Decrease mucosal edema and mucus production

- **Indications/Uses**
    - All of the foregoing are used in either the emergency treatment or maintenance of asthma, obstructive airway disease and reversible bronchospasm; may also be used in certain cases of anaphylaxis

- **Contraindications**
    - Known hypersensitivity to the drug being used or other drugs in the same subclass.

  - Ipratropium should not be used in patients with known sensitivity to atropine
  - Steroids should not be used as primary treatment of status asthmaticus

- **Precautions**
  - Albuterol and other beta agonists should be used with caution in patients with tachyarrhythmias or underlying cardiac disease
  - Transfer all patients on cardiac monitor and be alert for rhythm changes

- **Side Effects**
  - Common side effects include headache, dizziness, arrhythmias, palpitations, anxiety, nausea and chest pain

- **Significant Interactions**
  - Use of beta agonists with sympathomimetics may increase risk of arrhythmias

- **Routes of Administration**
  - Most of these medications are administered by inhalation; in certain cases any appropriate route may be utilized

- **Dosages**
  - Dosages will vary from patient to patient based on medical condition, age and size of the patient

- **Overdose/Toxicity Presentation**
  - Be alert for signs of hypersensitivity or exaggerated side effects. These may include the following:
    - Arrhythmias
    - Nausea/vomiting
    - Chest pains and/or palpitations

- **Treatment of Overdose/Toxicity**
  - General supportive measures
  - Treat arrhythmias and chest pain as per Maine EMS protocols
  - Consider anti-emetics for nausea/vomiting
  - Consider discontinuing medication or reducing dose
  - Contact medical control for further options

Section 5 Part XVII Sedatives Including Benzodiazepines and Barbiturates

- Included within this class are the following classes of medications that may be used either alone or in combination to produce sedation
    - Antipsychotics
    - Benzodiazepines
    - Barbiturates
    - Narcotics
    - Anesthetics
        - *Anesthetics are included in this section for informational purposes only as paramedics are not permitted to transport patients on these drugs unless accompanied by an RN or physician*

- **Common Medications in Class**
    - Narcotics
        - Morphine
        - Fentanyl
        - Hydromorphone (Dilaudid)
        - Meperidine (Demerol)
        - Butorphanol (Stadol)
    - Benzodiazepines
        - Diazepam (Valium)
        - Lorazepam (Ativan)
        - Midazolam (Versed)
    - Barbiturates
        - Phenobarbital
        - Secobarbital (Seconal)
        - Thiopental (Pentothal)
        - Amobarbital (Amytal)
        - Pentobarbital (Nembutal)
    - Antipsychotics
        - Haloperidol (Haldol)
        - Droperidol (Inapsine)
        - Chlorporomazine (Thorazine)
        - Risperidone (Risperdal)
        - Clozapine (Clozaril)
    - Anesthetics
        - Etomidate (Amidate)
        - Propofol (Diprivan)

- **Mechanisms of Action**
    - Barbiturates
        - Acts as a CNS depressant by increasing the action of GABA (gamma amonibutyric acid)
    - Anesthetics: produce rapid sedation and hypnosis

- Refer to Sections on Narcotics, Anticonvulsants (Benzodiazepines), Antipsychotics for further information on drugs contained in those classes

- **Indications/Uses**
  - Drugs in these classes may be used alone or in combination for the following indications:
    - Altered mental status
    - Combativeness
    - Control of seizure activity
    - Sedation associated with cardioversion
  - Anesthetic agents such as propofol are primarily used to maintain sedation in intubated patients during transport when accompanied by an RN or other appropriate personnel

- **Contraindications**
  - Refer to Sections on Narcotics, Anticonvulsants and Antipsychotics for contraindications associated with drugs in those classes
  - Barbiturates
    - Hypersensitivity to barbiturates, status asthmaticus, severe mental depression
  - Anesthetics
    - Hypersensitivity to the drug, severely elevated ICP

- **Precautions**
  - Use with caution in patients with hypotension, shock or respiratory depression; monitor vital signs frequently

- **Side Effects**
  - Common side effects include hypotension, bradycardia, dizziness, drowsiness respiratory depression, nausea/vomiting

- **Significant Interactions**
  - Use of any of these medications with other sedatives may cause increased CNS and/or respiratory depression or severe hypotension

- **Routes of Administration**
  - IV generally; under certain circumstances some medications may be administered by other appropriate routes such as IM or PO

- **Dosages**
  - Dosages of these medications will vary significantly based on patient condition, weight and age.

- Consult drug reference book for further information and discuss dosing with sending physician.

- **Overdose/Toxicity Presentation**
  - Apnea, bradypnea
  - Bradycardia
  - Hypotension
  - Other cardiac arrhythmias

- **Treatment of Overdose/Toxicity**
  - General supportive measures
  - Oxygen; be prepared to intubate
  - Treat bradycardia and other arrhythmias as per Maine EMS protocols
  - Consider fluid challenge for hypotension
  - Consider discontinuing medication or reducing dose
  - Contact medical control for other options

Section 5 Part XVIII Vasoactive Agents

- Definition: Vasoactive agents are medications that have an effect on the tone and caliber or diameter of blood vessels.

- Vasoactive agents include several subclassifications of medications.
  - Vasopressors and sympathomimetics
    - These are drugs that stimulate contraction of the muscles of the vessels and thereby cause constriction.
  - Nitrates, Vasodilators, ACE Inhibitors and Calcium Channel Blockers
    - These drugs work in different ways to promote the relaxation and dilation of blood vessels, thereby reducing blood pressure.

- **Common Medications in Class**
  - Vasopressors/Sympathomimetics
    - Vasopressin (Pitressin)
    - Metaraminol (Aramine)
    - Dopamine (Intropin)
    - Dobutamine (Dobutrex)
    - Epinephrine
    - Norepinephrine (Levophed)
    - Isoproterenol (Isuprel)
    -
  - Nitrates
    - Nitroglycerin

        - Nitroprusside (Nipride)
    - ACE Inhibitors
        - Enalapril (Vasotec)
        - Benazepril (Lotensin)
        - Lisinopril (Zestril)
        - Captopril (Capoten)
    - Calcium Channel Blockers
        - Diltiazem (Cardizem)
        - Nifedipine (Procardia)
        - Verapamil (Calan)
    - Vasodilators
        - Hydralazine (Apresoline)
        - Minoxidil (Loniten)
        - Diazoxide (Hyperstat)
        - Amrinone (Inamrinone)

- **Mechanisms of Action**
    - Vasopressors/Sympathomimetics
        - Drugs in this class act in slightly different ways to constrict vessels and increase blood pressure; have varying degrees of effect on alpha and beta adrenergic receptors
    - Vasodilators
        - These drugs all work by relaxing vascular smooth muscle
    - Nitrates
        - Rapidly relax smooth muscle and cause dilation of coronary arteries; reduce the work of the heart and improve cardiac perfusion
    - Calcium Channel Blockers and ACE Inhibitors
        - For information on these drugs, see the Section 5 Part VI on Antihypertensive medications

- **Indications/Uses**
    - Nitrates
        - Primarily used in the management of ischemic chest pain and/or hypertensive crisis
    - Vasodilators
        - Hypertensive crisis; management of CHF
    - Vasopressors/Sympathomimetics
        - Used to manage hypotension and shock; Vasopressin may also be used in cardiac arrest
    - Calcium Channel Blockers and ACE Inhibitors
        - Used in the treatment of hypertension; calcium channel blockers also used to treat various tachyarrhythmias

- **Contraindications**
    - Nitrates

        - Hypersensitivity to the drug
        - Use of anti-impotence medications within past 24 hours
        - Shock, hypotension
    - Vasodilators
        - Hypersensitivity to the drug
        - Hypotension
    - Calcium Channel Blockers
        - Hypersensitivity to the drug
        - Bradycardia, heart blocks
        - Cardiogenic shock
    - ACE Inhibitors
        - Hypersensitivity to the drug
        - History of angioedema with previous treatment with ACE inhibitors
    - Vasopressors/Sympathomimetics
        - Hypersensitivity to the drug
        - Hypovolemic shock unless substantial fluid replacement has taken place

- **Precautions**
    - All patients should be transported on a cardiac monitor
    - Monitor vital signs frequently

- **Side Effects**
    - Nitrates and Vasodilators
        - Headache
        - Dizziness
        - Hypotension
        - Nausea
    - Calcium Channel Blockers
        - Headache
        - Bradycardia
        - Hypotension
        - Nausea
        - Fatigue
        - Weakness
    - ACE Inhibitors
        - Headache
        - Nausea
        - Cough
        - Postural hypotension
        - Dizziness
    - Vasopressors/Sympathomimetics
        - Tachycardia
        - Hypertension

- Palpitations
- Headache
- Chest pain

- .**Significant Interactions**
  - Use of vadodilators, nitrates, calcium channel blockers and/or ACE inhibitors in combination with each other may have profound hypotensive effects and should be used very cautiously.
  - Use of epinephrine with other sympathomimetics may have profound effects

- **Routes of Administration**
  - IV in most cases but may be given by other appropriate routes such as PO in certain circumstances

- **Dosages**
  - Dosages will vary significantly based on the drug being used and the medical status, age and size of the patient.

- **Overdose/Toxicity Presentation**
  - Watch for the following:
    - Severe hypotension or hypertension
    - Dyspnea
    - Arrhythmias including bradycardia, tachycardia or heart blocks
    - Altered level of consciousness
    - Vomiting

- **Treatment of Overdose/Toxicity**
  - Provide general supportive measures; administer oxygen and monitor vitals and heart rhythm.
  - Further considerations
    - Consider discontinuing medication or modifying the dose where appropriate
    - Consider fluids for hypotension and vasopressors
    - Treat arrhythmias as per Maine EMS protocols
    - Contact medical control for further options

(Section 5, Objective 3) EXERCISE Using a case study of a hospitalized patient on medications the PIFT paramedic will be able to determine PIFT transfer eligibility based on medication classification.

(Section 5, Objective 4) EXERCISE Using a case study of a hospitalized patient on medications the PIFT paramedic will be able to determine dose,

significant side effects, contraindications, precautions and treatment considerations and management using a PIFT drug resource.

Section 6 Devices

Terminal Objective:
At the completion of this section the student will understand the basic mechanical principals, basic operation and troubleshooting of PIFT devices.

Enabling Objectives:

The student will be able to:

Note: the following parts of Section 6 are designed to give the student a basic overview of common PIFT related devices. Although particular devices will be presented, this section is not meant to teach the workings of specific devices.

Complications of Devices in General
The majority of complications associated with the devices that will be used for interfacility transfer will occur with the initiation of the procedure, or long after the transport has been completed.
That being said, there should be a significant emphasis on patient preparation prior to transport:

- *All tubes and lines should be checked and taped or sutured into position.*
- *Extra batteries and additional medical equipment should be prepared in anticipation of specific transport-related complications.*

An ounce of prevention now may save you and your patient from difficult transfer later.

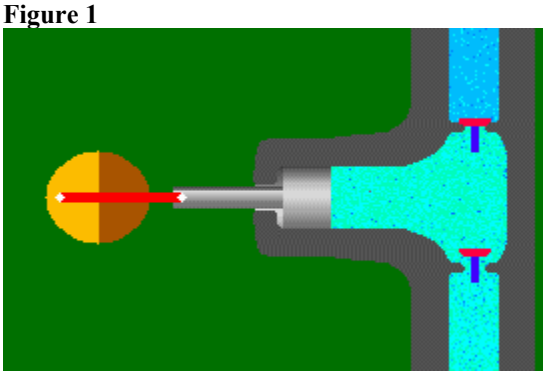
Section 6 Part I Pumps

(Section 6, Objective 1) Describe the basic mechanical principals of infusion pumps including syringe pumps.

Note: *Various pumps exist, with significantly different mechanics. These mechanics are important, depending on the type of transport. For example, diaphragm pumps tend to not work well at high altitudes. Peristaltic pumps are prone to air bubbles. It is important to understand the mechanism, action, disadvantages and advantages to the particular pump that is used at your organization.*

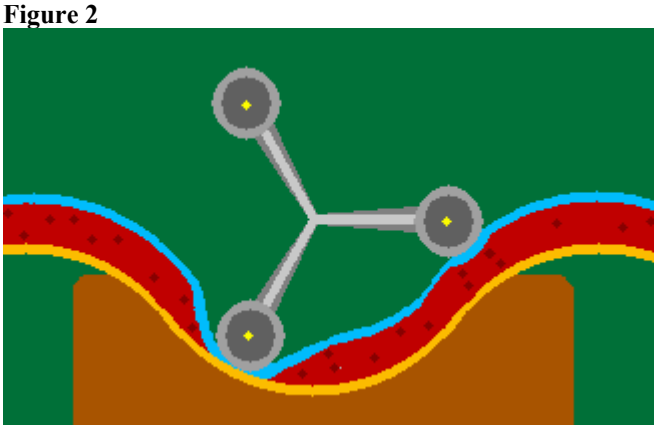
a. **Piston Pumps**
   - Work when a piston moves back, allowing fluid into a chamber through a one way valve. When the piston moves forward, fluid is pushed out of the chamber and into the IV line. (See Figue 1)

Figure 1



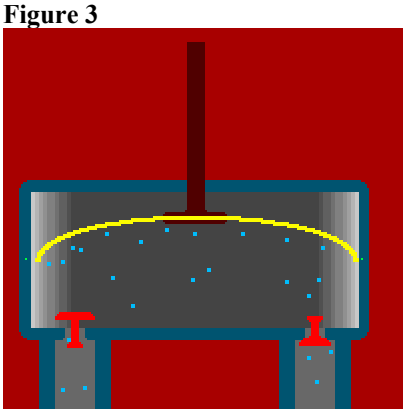
b. **Peristaltic pumps**
   - Have a rotating head that pushes fluid along in a tube. Because the turning is continuous, fluid can't go backwards. The rate of administration is controlled by the speed of rotation. (See Figure 2)

Figure 2



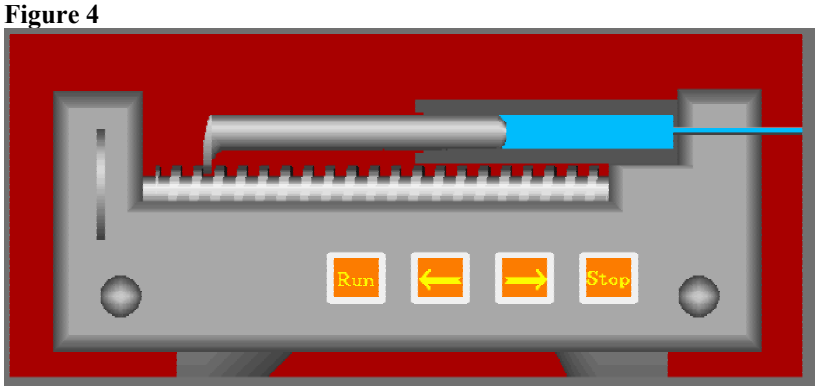
c. **Diaphragm Pumps**
   - Have a thin spring loaded diagram that moves up and down. The pressure changes cause fluid to rush into the negative space created by the diaphragm (just like the thoracic cavity). (See Figure 3)

Figure 3



d. **Syringe Pumps**
   - Have a turning shaft that causes the syringe cylinder to move in as the shaft is turning. (See Figure 4)

Figure 4



e. JCAHO now requires that all new pumps manufactured and used should be “smart pumps”. This allows medications and doses to be calculated on the pump. Recent studies show errors rates have decreased significantly by utilizing the smart pump features.

f. Computerized smart pumps also allow for medication tracking. Most have the capability of monitoring volumes, times of rate changes, times of medication changes, etc. This permits retrospective review of pumps actions, typically over the previous 48 hours.

g. Volumetric pumps and micro-volumetric pumps are designed and capable of administering small or large volumes of medication, which is not possible when using gravity IV systems.

h. It is important to become familiar with the types of alarms and how they can be corrected. All pumps are required to have air sensors and most have optical sensors to measure accurate volumes.

i. Single chamber, dual chamber, and multi-chamber pumps are now

available. Be informed about where and whether medication mix, and whether alternate IV sites are required prior to departure. Verify medication compatibility.

(Section 6, Objective 2) Demonstrate infusion pump operation to include: tubing set up, on-off and rate adjustment of a common (typical) infusion pump.

a. Prime the tubing with the solution following the manufacturer's recommendations. Be sure all air is removed.

b. Place the tubing, cartridge or syringe in the chamber.

c. Set the rate, volumes to be infused, remove IV line clamps, and start the pump assure that the pump is infusing, then connect to your patient.

d. Monitor infusion rates and IV sites for complications.

e. Alarms indicate that the precise rate of fluid administered cannot be assured. The first step with any alarm sound includes assessing the patency and integrity of the system.

f. **(EXERCISE)** Take some time to become familiar with the pump you will be using, before the actual call.

(Section 6, Objective 3) Diagnosis and correct common infusion pump problems to include: blockages or power failure.

a. Individual pumps vary from manufacture to manufacture. Troubleshooting is specific to each make of pump. Be familiar with each type of transport pump available to you. The range of safety features varies widely with the age and make of pump. A state of the art pump may have the following safety features:

    - All makes have no single point of failure. That is, no single cause of failure should allow the pump to silently fail. At the minimum, it should stop functioning or make an audible alert. This is a minimum requirement on all human-rated infusion pumps of any age. It is not required for veterinary infusion pumps.
    - Batteries, so the pump can operate if the power fails or is unplugged.
    - Anti-free-flow devices prevent blood from draining from the patient, or volume from freely entering the patient, when the infusion pump is being set-up.

- A "down pressure" sensor will detect when the patient's vein is blocked, or the line to the patient is kinked.
- An "air-in-line" detector. A typical detector will use an ultrasonic transmitter and receiver to detect when air is introduced to the closed system. Some pumps actually measure the volume, and may even have configurable volumes, from 0.1 to 2 ml of air. None of these amounts can cause harm, but sometimes the air can interfere with the infusion of a low-dose medicine.
- An "up pressure" sensor can detect when the bag or syringe is empty, or even if the bag or syringe is being squeezed.
- Many pumps include an internal electronic log of the last several thousand therapy events. These are usually tagged with the time and date from the pump's clock. Usually, erasing the log is a feature protected by a security code, specifically to detect staff abuse of the pump or patient.
- Many makes of infusion pump can be configured to display only a small subset of features while they are operating, in order to prevent tampering by patients, untrained staff and visitors.

Section 6 Part II Foley Catheters/Continuous Bladder Irrigation

(Section 6, Objective 4) Describe the fundamental purpose of continuous bladder irrigation.

a. Continuous bladder irrigation is utilized to keep the bladder free of clots and to maintain the patency of the urethra in patients with complications of infection or postoperatively.

b. CBI can be either open or closed. In an open system, the bladder is drained using a 60 ml syringe. In a closed system, the bladder drains directly into a foley bag.

c. CBI involves instilling sterile irrigation solution into the bladder, then allowing that fluid to drain out. Failure to recognize that the fluid isn’t draining can result in severe bladder injury, as large volumes of irrigation solution are typically instilled.

d. Typically, triple lumen catheters are used. One port is to fill the balloon so the catheter stays in place, one is used to infuse fluid, and the last is used to drain fluid.

(Section 6, Objective 5) Describe the physiology and basic operation of Foley Catheters and continuous bladder irrigation.

a. The indications of a Foley catheter insertion include:
    - management of chronic incontinence
    - monitor of fluid balance status (ie monitor output carefully (1ml/kg/hr is the minimum expected volume for kids, 30 ml/hr for adults)
    - allow for bladder irrigation or drainage post operatively
    - resolve obstruction (ie prostate)

b. Indwelling Foley catheters consist of a drainage tube, with an inflatable balloon to prevent inadvertent removal. Balloon are inflated with sterile water only, as saline causes the balloon to deteriorate.

(Section 6, Objective 6) Describe the aspects of "normal operation/expectations" for Foley Catheters and continuous bladder irrigation.

a. When caring for a catheter that is already in place, the major tasks include:
    - Assuring adequate urine output, without obstruction.
    - Assuring the system remains closed to prevent infection.
    - Keeping the Foley bag below the level of the bladder, to prevent urine from the bag from flowing back into the bladder.
    - Assessing the bladder to make sure there is no pain or distention.
    - Preventing accidental dislodgment by assuring that the foley balloon is inflated, and the bag is appropriately secured.

b. When caring for a patient with CBI, the major tasks include
    - Monitoring the color and type of drainage. Postoperatively, clots and small volumes of blood are expected. Bright red blood, or large volumes of drainage may indicate active bleeding.
    - Maintaining close input and output balance. All instilled fluid should be measured. Output is also measured. (fluid out minus fluid in = patient losses)
    - Maintaining catheter patency, and delivering instilled fluid at the ordered rate.
    - Preventing infection by using strict aseptic technique.

c. Normal expectations for foley care:
    - Pain free
    - Free flow drainage of clear or amber urine of at least 30 ml/hr

d. Normal Expectations for CBI:

- Cloud, tea colored, or bloody urine
- Free flow of catheter, with occasional clots
- Free of bright red, or high volumes of bleeding or drainage
- Frequent bladder spasms and cramps, which may be reduced with pre-medication. Increases in spasm may indicate outlet obstruction.

(Section 6, Objective 7) Diagnosis and correct common problems such as equipment failure, clogged/kinked tubing, and extubations.

a. The main complications are tissue trauma and infection. Care should be taken when a Foley catheter is in place to protect the catheter from undue movement. The most common short term complications are inability to insert catheter, and tissue trauma during the insertion.

Complication	Action	Notes
Catheter draining little or no urine despite adequate fluid intake	Consider level of drainage bag Consider flushing catheter	Bag should always be lower than level of the bladder to prevent black flow of urine
Unexpected removal	Do not reinsert tube.	Retained catheter fragments are usually the result of balloon rupture (catheter disruption, in this case) and can potentiate many complications. The Catheter must be inspected to determine potential of catheter fragments in the bladder.
Infection	None during transport	After 48 hours of catheterization, most catheters are colonized with bacteria, thus leading to possible bacteruria and its complications. Catheters can also cause renal inflammation, nephro-cysto-lithiasis, and pyelonephritis if left in for prolonged periods.

Bleeding into or around the catheter	Control bleeding if external	Monitor for cessation of flow; consider flushing catheter
Urethral swelling around the catheter	None during transport	Contact OLMC for consultation with significant swelling
Leakage of large amounts of urine around the catheter	None during transport	Contact OLMC for consultation to consider flushing the catheter

Section 6 Part III Central Lines

(Section 6, Objective 8) Identify the basic anatomy and physiology pertaining to central lines.

a. Central venous lines typically are inserted in the internal jugular or subclavian veins. The catheter tip enters directly into these large veins. Central lines are utilized in patients requiring long term IV therapy, I patients who had poor peripheral IV access, or in clients requiring large volumes of fluid. Various types and manufacturers of Central Lines exist.

b. Dual lumen, triple lumen and quad lumen lines are used, allowing for administration of various medications simultaneously, without the risk of in line medication compatibility issues.

c. Some central lines are peripherally inserted (PICC lines).

d. See the MEMS Central Venous Access document (Appendix A) for additional information regarding central lines.

(Section 6, Objective 9) Describe the aspects of "normal operation/expectations" for central lines.

a. When accessing central lines to give medications or connect to a fluid source, it is critical to maintain sterile technique. Nosocomial infections from central lines are one of the major contributors to patient death. Sterile gloves and mask are typically worn when changing dressings or cleaning the site.

b. Prior to departure, determine which lines are being utilized, which

medications are going to which line tale. Flush each line prior to departure following the manufacturer's recommendations. Cover the site with an occlusive dressing and avoid touching the site during transport.

c. Assess the insertion site frequently for bleeding, infiltration or signs of infection. Monitor IV fluid administration closely, as large volumes can be infused over a short period of time. Be sure all ports are secure and all clamps are closed. Loss of a clamp can result in rapid bleeding, due to the large vessels that are cannulated.

d. Accidental dislodgement can result in high volumes of bleeding. If dislodgement occurs, maintain direct pressure for 5-10 minutes. Because of the anti-coagualants used to maintain line patency, recurrent bleeding may occur.

(Section 6, Objective 10) Recognize and troubleshoot a common problem such as unexpected removal.

a. Complications with central lines generally occur at time of insertion and vary by site of insertion. In one study, (Steele R, Irvin CB: Central line mechanical complication rate in emergency medicine patients. Acad Emerg Med 8:204, 2001) complications were defined as pneumothorax, hemothorax, or any issue with the CVC excluding infection or thrombosis that required an inpatient consultation.

Complication	Action	Notes
Unexpected removal	Treat as open wound with occlusive dressing and direct pressure.	Contact OLMC for consultation
Shortness of breath	Observe patient for s/sx of tension pneumothorax	Monitor for pneumothorax with any subclavian or internal jugular vein cannulation

Section 6 Part IV Transvenous Pacemakers

(Section 6, Objective 11) Describe the anatomy and physiology pertaining to transvenous pacers.

a. Transvenous pacemakers are inserted into the right ventricle, where the pacemaker contacts the endocardium near the ventricular septum. The lead is connected to a small pulse generator.

b. Transvenous pacemakers are deliver electrical currents that stimulate cardiac depolarization. They are used to treat symptomatic bradycardia, heart blocks, or sick

sinus syndromes. They may also be sued to override symptomatic tachycardias.

c. Transvenous pacemakers can be permanent or temporary, depending o the clinical situation.

d. Newer pacemakers typically are dual chambers, where both the atria and the ventricles are stimulated.

(Section 6, Objective 12) Describe the fundamental operation of a transvenous pacer.

a. Pacemakers are set for rate and mode.
   - Demand mode indicates the pace maker will only generate an impulse if preset parameters are met (ie HR falls below 60).
   - Asynchronous pacers pace the heart at a set rate regardless of the patients own electrical or physical activity.

b. The electrical output is how much activity is needed to generate an impulse that results in depolarization.

c. Pacer rhythms are fairly distinctive and therefore easy to identify on a rhythm.

(Section 6, Objective 13) Describe the aspects of "normal operation/expectations" for transvenous pacer operation.

a. Patients with newly inserted pacemakers typically will complain of localized pain, as well as pain associated with each battery generate impulse. Analgesic medication and anti-anxiety medications may be appropriate.

b. Patients should be monitored closely for the complications outlined below. Failure to recognize transvenous pacemaker malfunction quickly could result in patient demise.

(Section 6, Objective 14) Recognize and troubleshoot a common problem such as failure to capture, equipment failure, electrode wire breakage.

a. Complications of emergency transvenous cardiac pacing are numerous and are similar to those related to central venous catheterization, right heart catheterization (dysrhythmias with PVC's), and transvenous pacing.

Complication	Action	Notes
Failure to capture	Adjust current to the minimum current necessary to obtain capture	

Undersensing	Increase sensitivity number on generator	
Oversensing	Decrease sensitivity number on generator	
Equipment failure	New battery prior to transport	Additional backup battery for transport
Displacement, fracture of the catheter, loose leads	Contact OLMC for consultation	Suspect with intermittent or complete loss of capture after other causes have been considered

Section 6 Part V Chest Tubes

(Section 6, Objective 15) Describe the basic physiology of chest tubes and pleural vacuum.

a. Chest tubes are used to drain fluid and air from the pleural space or mediastinum. Indications include pneumothorax, empyema, hemothorax, or hemopneumothorax

b. Normal negative pressure in the pleural space is maintained, allowing for improved ventilation and oxygenation.

c. Water seal systems are used to maintain negative pressures. Typically, pleurevacs or thoraclex (and others) are connected to continuous suction to allow for drainage from the thoracic cavity.

(Section 6, Objective 16) List the basic equipment associated with chest tubes including the Heimlich valve and the water seal.

a. Chest tubes are sutured in place, however care should be taken to prevent accidental removal.

b. Equipment needed during transport includes a functioning suction unit, tape, occlusive dressing, pleurevac or Heimlich valve. Pleurevacs should be secured to prevent spilling of fluids and inadvertent introduction of air into the pleural cavity. Continuous or intermittent negative pressure should be maintained, as ordered.

c. Heimlich valves are one way valves that prevent air from entering the pleural space through the chest tube, but permit air to drain out. They may be preferred for simple pneumothrorax during transport because they don't require water filled containers.

(Section 6, Objective 17) Describe the aspects of "normal operation/expectations" for chest tubes including Heimlich valve and water seal.

a. It is important to verify tube placement prior to departure, and after each transfer. Record where the tube is taped in cm, and assure that the tube is properly secured. Retape all connections as needed.

b. A normally functioning chest tube with pleurevac should have air bubbling in the water seal chamber that fluctuates during inspiration and expiration (tidaling).

c. Monitor drainage carefully. Bright red drainage indicates active bleeding.

d. Avoid "milking" or clamping the tube.

e. Assess frequently for placement, crepitus at the insertion site, leakage, and monitor connections carefully.

f. Assure that the water seal chambers are filled appropriately.

(Section 6, Objective 18) Recognize and troubleshoot common problems such as disconnection or blockage and leakage.

a. The most common complications of chest tube insertions include infections, laceration of an intercostal vessel, laceration of the lung, and intra-abdominal or solid organ placement of the chest tube.

Complication	Actions	Notes
Recurrent pneumothoraces with chest tube failure	Observe patient for s/sx of tension pneumothorax	
Mechanical failure to drain air or fluid	Ensure that drainage collection is secure and below the level of the tube insertion	
Tube obstruction: Blood clots, kinks	Place and tape tubing to prevent kinks. Obstruction for by any other means, contact OLMC for consultation	

Unexpected removal	Treat as open chest wound. Immediately apply sterile occlusive dressing: Do not reinsert tube.	Remember to ventilate occlusive dressing to relieve tension pneumothorax. May need to divert to acute care facility to stabilize patient and replace chest tube.
Increased bleeding from chest tube	Do not clamp chest tube	Contact OLMC for consultation
Chest tube disconnects from drain unit	Keep bottle of sterile saline or water with patient, if chest tube disconnects from drain unit, submerge end in the water This is done instead of clamping to prevent another pneumothorax. Air is still allowed to escape.	
Infection of the entry site or pleural fluid	None	Prophylactic antibiotics are controversial
Bleeding at site	Control bleeding with direct pressure	

Section 6 Part VI Orogastric and Nasogastric Tubes (OG/NG Tubes)

(Section 6, Objective 19) Describe the basic physiology of orogastric and nasogastric tubes.

a. Nasogastric and orogastric tubes are inserted to empty abdominal contents, to promote release of air, to prevent gastric distention, to provide a route to administer medications and feedings, and in cases of GI bleed or abdominal surgery, to drain blood or perform gastric lavage.

b. The nasogastric tube is measured from the edge of the nose, to the angle of the jaw, and down to the xiphoid process. The orgastric tube is measured from the corner of the mouth instead of the nose. They may connected to intermittent or continuous suctioning, or be open to the air.

c. The preferred way to determine correct tube placement is to measure the

pH of the aspirate using pH strips. Gastric content pH is less then 4, intestinal contents are greater than 4, and respiratory secretions typically greater than 6.

(Section 6, Objective 20) List the basic equipment associated with OG and NG tubes.

a. Levin tubes are single lumen, with holes near the tip of the tube. Salem Sump tubes have two lumia; one is for gastric contents removal, the other is for air venting.

b. An anti-reflux valve is often used when the tube is not connected to the suction unit.

c. A 60 cc syringe with a catheter tip is used to verify position and to aspirate contents.

(Section 6, Objective 21) Recognize and troubleshoot common problems such as extubation or blockage.

a. The main complications of NG tube insertion include aspiration and tissue trauma. Additional complications are at time of placement. Placement of the catheter can induce gagging or vomiting, therefore suction should always be ready to use in the case of this happening.

Complication	Action	Notes
Unexpected removal	Do not reinsert tube.	Anticipate need for suction Anticipate vomiting
Sinusitis	None during transport	
Aspiration	Place head of be at 30 degrees	
Nasal Hemorrhage	Place head of bed at 30 degrees	
Passage of the tube into the trachea	Confirm by placing external end of tube into bottle of saline and observing bubbles	Contact OLMC for option of tube removal
Perforation of the esophagus	None during transport	
Gastrointestinal bleeding	None during transport	
Coiling of the tube in the	Place head of bed	Monitor for aspiration

posterior pharynx	at 30 degrees	